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OF THE

National Fire Protection Association

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National Fire Protection Association.

Executive Office, 87 Milk Street, Boston, Mass.

Franklin H. Wentworth, Secretary

October, 1919

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Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Insurance Bureau.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Courtesy G. A. Beall, Columbus, Ohio.

A HAZARDOUS GARAGE.

The conditions in the garage shown above are unfortunately common. Note furnace with open fire, gas containers, oil barrel, and poor electric wiring in a room having a wooden floor and joisted ceiling.

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Intensive Fire-Prevention Education.

The Fire Prevention Bureau of the Pacific under the able direction of Mr. Jay W. Stevens, whose presence at the N. F. P. A. annual meeting in Ottawa this year is so pleasantly remembered, is the first organization of the country to undertake, in the cities under its jurisdiction, an intensive campaign of fire-prevention education. There is not a great number of large cities west of the Rocky Mountains, but at the conclusion of the Bureau's present effort they will all be alive to the importance of the fire waste. In planning meetings the Bureau has the assistance of its resident engineers in the principal cities, and in executing the plans Mr. Stevens has the assistance of Mr. J. H. Shively as publicity manager, an interesting and persuasive speaker. Interest in the prospective meetings is worked up in advance through all available sources including the local newspapers. Mr. Stevens and Mr. Shively then arrive for a several days' visit, having noon meetings with the Chambers of Commerce, Credit Men, Rotary Clubs, Elks, and other men's organizations, afternoon meetings with the women's clubs and evening mass meetings where both speaking and motion pictures are utilized. The mornings are spent in speaking at the grade and high schools interesting the pupils in domestic fire hazards and enlisting their co-operation with the fire chief, as the fire wardens of their homes.

The effects of this sort of campaign cannot, of course, be estimated, but the response of the school pupils alone is sufficiently enthusiastic to warrant high hopes. The cities are thoroughly aroused by the plan; the fire chiefs stimulated and encouraged, and the friends of the cause already made are given new life and energy. This plan is to be carried out annually and will be watched with keen interest by the members of our association.

* * *

Secretary Wentworth's Speaking Tour.

Secretary Wentworth has been actively assisting in the above campaign, having joined Messrs. Stevens and Shively at Boise, Idaho, on September 11th, where school and noon meetings were held and an audience of a thousand people assembled in the park for the evening meeting. Mr. Shively remained in Idaho for a tour of the smaller cities

of that state, Messrs. Stevens and Wentworth proceeding to fill engagements at Spokane, Tacoma and Portland. The Fire Chiefs of the Pacific were assembled in Portland in annual convention and promised wholehearted co-operation in Mr. Stevens' campaign which because of their close identification with it is very much their own. Messrs. Stevens and Wentworth then went to Montana to the state fire chiefs' convention at Dillon, rejoining Mr. Shively at Butte, from whence Messrs. Stevens and Shively went on tour in Montana, leaving Mr. Wentworth to meetings in Butte and to proceed alone to carry on the work successively in Ogden and Salt Lake, Utah, and in Sacramento, Santa Barbara and San Diego, California. Mr. Stevens rejoined Mr. Wentworth at Los Angeles for the meetings in that city, San Francisco and Oakland, where the campaign was concluded by meetings on Fire and Accident Prevention Day, October 9th, the first time this day had been observed in California in October, thus making October 9th the uniform date for this observance throughout the United States and Canada. From California Secretary Wentworth went to Denver, where meetings had been planned by Fire Chief John F. Healy (member N. F. P. A.) on his own account, Denver not being in Pacific territory. Mr. Wentworth returned to Boston via Chicago, speaking at conventions of affiliated members en route.

* * *

Boy Scout Firemen at Salt Lake. During Secretary Wentworth's visit to Salt Lake, Fire Chief W. H. Bywater (member N. F. P. A.) seized the opportunity to call into conference the executives of the Boy Scouts, and I. W. Story, local engineer of the Fire Prevention Bureau of the Pacific, for the purpose of creating an organization of scout firemen similar to that of Spokane, Wash., which functions so successfully under Fire Chief Weeks of that city. One hundred boys are to be selected and apportioned to four divisions of the city. They are to be instructed in fire prevention, and on qualifying are to be given badges by Fire Chief Bywater and considered members of the department. They are to report brush and grass fires, piles of rubbish and other fire-breeding conditions; guard the streets as traffic guides during big fires, instruct citizens in transmitting fire alarms, watch for the false alarm pests, and generally serve as a department fire prevention squad. Chief Bywater is to give prizes to the section showing the best record in reduced alarms and other items.

* * *

Standardization of Fire Department Practice. Chief John Kenlon is to be congratulated on his desire to render his tenure of the presidency of the International Association of Fire Engineers memorable through the initiation of a movement to standardize fire department practice throughout the country. In the past the application of scientific method to fire service problems has been difficult, owing to the slow and uneven development of fire departments from volunteer groups of public-spirited citizens, without special training, into the highly specialized professional forces upon which our

great cities now depend for their protection. Another factor which has had an unfavorable influence is the intrusion of politics into the field of fire department organization. Although these unfavorable conditions cannot yet be regarded as belonging wholly to the past, Chief Kenlon is of opinion that the time is ripe for a determined effort to grapple in a systematic way with the difficulties of modern fire-fighting. With this end in view he has appointed a number of special committees to study and report upon various matters of practice, and he has also impressed upon his fellow members of the I. A. F. E. that, if the great task to which they have now set their hands is to be satisfactorily accomplished, it will be necessary to work hard to increase the membership and influence of their organization in the fire service as a whole.

At the same time the question of fire department efficiency is being attacked from another angle by the *Committee on Fire Department Co-operation* which has recently been appointed by the N. F. P. A. executives, and of which Chief T. G. Toomey, of Boston, is chairman. Means are to be devised whereby in every large city the local membership of the National Fire Protection Association may form a nucleus around which a body of public interest in the activities of the fire department may be built up. Nothing can be more helpful to the competent fire chief than the existence of a considerable group of citizens who want to know the truth about existing conditions, who believe that the safety of the city should be removed from the sphere of petty politics, and who have a sympathetic understanding of fire department problems.

* * *

Women as Forest Fire Fighters.

Forest fire protection is now among the new activities into which women have entered and in which they have made good. The following account of the achievements of two Butte school teachers in this field makes interesting reading:

Women fire lookouts in the Bitter Root valley have come into their own. The forest service has just tried two in the great Missoula wilderness of Montana and awarded to them the red badge of courage and, for efficiency, the blue.

This is not an initial experiment. The service has about a dozen women on its rolls acting as lookouts, most of them the wives or daughters of men who have been so employed and who were to the business born. There are perhaps a half-dozen from the outside world who have applied for the job and made good at it. Not all aspirants do so. The work calls for long solitary vigils on lonely mountain tops, constant watchfulness, keen eyes, good judgment, quick decision in emergencies, and the strength and ability to fight a fire for hours at a time.

Few women have all these requirements, but now and then one is found whose wits supply whatever she lacks of other qualities. Such women are said to make better lookouts than most men, and the service is ready to try out any woman once.

These two teachers of Butte are regarded as a find. This valuation is based on the following report from W. W. White, forest supervisor to the district forester and sent to Washington:—

"In reply to your inquiry about the two women lookouts on the Bitter Root, I would say that they served on Bare Con and Nezperce peak lookouts. Their services were satisfactory. In fact, they were better than the average man employed in 1918. Both women were teachers in the Butte public schools. One of these young women was a good story-teller, jolly and an all-round good mixer.

She had exceptional ability as a walker, in finding her way about the hills, and in taking care of herself in the mountains. On the first or second night in camp on the lookout lightning struck a tree and set fire to the crown within 50 yards of camp. The young lady admitted that she was panicky for an instant, but she did all that a man could have done. With shovel and ax she suppressed and guarded the fire until she thought it was safe. Her judgment of 'safe' proved correct; it was dead out.

"The other young lady was rather new to the hills. She had the rare combination of culture and common sense that commanded the respect of us all. This quality, coupled with gameness to see anything through, once started, was pretty certain to make her work satisfactory. One or two fires were started by lightning within one or two miles of her lookout. The young lady did not call for help, but reported the fires and also the fact that she was going to try to put them out at once. She did it.

"The diary of this last young woman is not of value because of any direct suggestions made concerning our forest problems, but is of interest because of its literary quality and the romance, enthusiasm and imagination she puts into things which are the most prosy, humdrum things in the world to a forest officer."

* * *

Safeguarding Frame Construction. It is very encouraging to notice the amount of attention that is now being given to the problem of reducing to a minimum the fire hazards that are inseparable from combustible construction. The interest of the National Lumber Manufacturers' Association (Member N. F. P. A.) in standard methods of fire-stopping in frame buildings, and in the proper construction of chimneys and its refusal to recommend the use of wooden shingles in congested district, are evidence of the new spirit. The Associated Metal Lath Manufacturers (Member N. F. P. A.) are also doing much to educate the public as to the undesirability of using small pieces of wood in dwelling construction. Our member advocates the making of tests with model test houses to demonstrate the retardation of the spread of fire in a frame building in which metal lath and fire-resistive roofing are used, as compared with a similar structure having wood lath and wooden shingles. The drawings and detailed instructions that are being circulated by our member in this connection have an educative value of their own in that they help to diffuse knowledge among the lathers, plasterers and carpenters as to what is good practice from a fire protection viewpoint.

* * *

Fire and Accident Prevention Day. Members will already have seen in the press accounts of the observance of October 9th, 1919, as Fire and Accident Prevention Day. Inasmuch as no attempt was made to develop new methods of observance, the story of the exercises is omitted from the QUARTERLY this year. It may be noted, however, that the ideas with which our readers are familiar were put into practice on a larger scale than in previous years. Co-operation between local members of the National Safety Council and of the National Fire Protection Association was again a powerful factor in promoting the success of the observance in many cities. Heavy demands were made for the N. F. P. A. *Syllabus for Public Instruction in*

Fire Prevention, practically exhausting the stock on hand. This fact is among the encouraging signs of the serious spirit which is coming to pervade the exercises of Fire and Accident Prevention Day.

* * *

The Menace of the Garage. The urgent need for more stringent supervision of conditions in garages is forcibly illustrated by the collection of hazards shown in the frontispiece of this issue of the QUARTERLY. Our contemporary, *Safety Engineering,* drew attention last month to a more recent example of foolhardiness involving a terrible life hazard. In a New Hampshire summer resort with poor fire fighting facilities there is being erected a garage that will accommodate one hundred or more touring cars. It is estimated that the quantity of gasoline in the reservoirs will average 1,000 gallons. The area is such as to endanger the stability of the ceiling of flat tile arches in the event of a serious fire. The walls are stone, but the tall windows reach up behind the sloping eaves of a large 2½-story light frame, shingle-covered gambrel that surmounts the garage and is intended to provide sleeping and living quarters for possibly 200 chauffeurs and attendants. It is easy to picture what would happen if a blaze in the garage caused the eaves and sloping shingled surfaces to ignite. As our contemporary justly remarks, "such construction as this can only be viewed in the light of preparation for an appalling disaster."

* * *

Glass Kerosene Lamps. Very probably the opinions as to the merits of the glass lamp expressed by member Charles E. Worthington in the article "Kerosene Lamp Explosions," which appears on another page will startle some of his fellow members. Certainly this type of lamp has been roundly condemned in authoritative quarters, but Mr. Worthington is not afraid of being unorthodox. Some of his fire protection heresies of former years have become part of the orthodoxy of today, and whether his views on the subject of glass lamps are accepted or rejected, what he writes is always thought-provoking.

Chicago Sprinkler Ordinance Sustained.

A decision which will be of interest to all N. F. P. A. members was recently handed down by the Supreme Court of the State of Illinois. A corporation known as the Washingtonian Home of Chicago failed to equip a building owned by it with an approved system of automatic sprinklers as required by the city fire prevention ordinance. The penalty provided by the ordinance for violation of the provision with reference to installation of sprinkler equipments is a fine of not less than $5 nor more than $200 for each offence, each and every day a building is occupied in contravention of the ordinance to be considered a separate and distinct offence. Action was brought by the city authorities in the Municipal Court, and the corporation was found guilty. An appeal was taken, in which, among other points, the question of the constitutionality of the ordinance was raised. As members will note, however, from the quotations given below, the case is instructive in a number of other respects. The attitude of the Washingtonian Home corporation in a matter which vitally affected the safety of the patients housed in their building, for example, once more forcibly illustrates the need for educational work among those responsible for the management of such institutions.

The following observations prefatory to the decision itself give a description of the circumstances in which the sprinkler equipment was required:

It is stipulated that the building of the Appellant is not equipped with an approved system of automatic sprinklers; that the Appellant is a charitable corporation and is not organized for profit, and in carrying out its corporate objects cares for certain inebriate patients without charge, and makes charges for the care of certain patients able to pay; that the expenses of the institution equal in amount its receipts from certain charitable trust funds and other sources; that the Appellant is endowed with valuable grounds and buildings thereon; . . . that the plans and specifications attached shall be a part of the stipulation; that the Appellant conducts in the second, third, fourth and fifth stories in section "A" shown in said plan, and in all the stories of sections "B" and "C" shown therein, an institution for the care, cure and reclamation of inebriates, and has since said building was erected; that all of the first floor "A" except the hall and entrance is occupied by stores, namely, a drug store, shoe store and grocery store, including the basements of the respective stores; that the stores contain the usual and ordinary oils and inflammable materials that are incident to such business; that section "A" of the building was built in 1875, section "B" in 1880, and section "C" in 1883; that all are lighted with gas; that there are hallways and communications between such sections; that all of said sections are in a class 2c described in section 16a of the ordinance. The stipulation also sets out the material used in construction of the outside walls and interior partition. Defendant has been notified by the bureau of fire prevention and public safety to install an approved system of automatic sprinklers as provided for in the ordinance, and has never submitted plans for such system for approval or installed such a system. The stipulation also sets out a comprehensive description of an approved system of automatic sprinkler system. It is also stipulated that in Section "A" are sleeping

accommodations for sixty-one persons, in Section "B" for seven persons, and in Section "C" for forty-four persons; that said sections are operated as one building; that certain windows, rooms and fire escape exits are barred with iron gratings, mostly permanent, and some locked with padlocks to prevent the escape of patients under treatment; that there are three padded cells with heavy doors, used for the confinement of violent patients, locked with padlocks when so used. The stipulation also contains a statement of the advantages of the use of a sprinkler system.

It is interesting to observe what the Court had to say about the appellant's contention that the Washingtonian Home was not covered by the ordinance:

Appellant argues numerous assignments of error. Its principal contentions are, however, that the ordinance does not apply to the buildings and premises of the appellant; that the action is barred by the Statute of Limitations, and that the ordinance is unconstitutional and void because not within the power of the city council to pass.

In support of the first contention appellent cites Section 24 of the ordinance, as follows:

"The following buildings hereinbefore referred to shall be equipped with an approved automatic sprinkler system, except as otherwise provided: * * *

"Class IIb and IIc Buildings.—On all floors and basements of non-fireproof buildings more than two stories in height, and having an area of more than 6000 square feet, except in sleeping rooms, reading rooms, parlors, bath rooms, dining rooms, smoking rooms, gymnasiums, and except hallways containing stair or elevator shafts enclosed with incombustible or fireproof material."

The evidence and stipulation in the record show that said premises consist of three buildings used and operated as one building. Said buildings are connected by passageways, so that they form, in fact, one structure. We are of the opinion that the structures in question should be treated as one building. This being true, a computation shows that the ground space occupied by said buildings amounts to more than 6000 feet.. It is contended that the space referred to in the ordinance should be construed as being floor space and not ground space. If this contention be adopted it can avail appellant nothing, as the floor space on all floors would necessarily be computed. In either view of the matter it is clear that the buildings occupy more than 6000 square feet, and come within the purview of Section 24 of the ordinance.

Dismissing with a few words the point raised as to the application of the Statute of Limitations, the Court took up at some length the question of constitutionality. The decision was that the ordinance was a reasonable exercise of police power, and we believe that members will be interested in the reasoning upon which this conclusion was based. We reproduce it in full:

The principal contention of appellant is that the city is without power to pass the ordinance in question. Such an ordinance, to be valid, must be within the police power of the State, which may be delegated to city councils. *Biffer* v. *City of Chicago*, 278 Ill. 562; *Williams* v. *City of Chicago*, 266 id. 267; *City of Chicago* v. *Mandel Bros.*, 264 id. 206.) Section I of Article 5 of the Cities and Villages Act provides the powers of city councils. An examination of paragraphs 61, 62, 63, 65, 66, 71, 75, 77, 78 and 98 shows that the city council has the general power to regulate the construction and maintenance of buildings of the character of the one in question here. A municipality has power to pass any ordinance which is necessary or proper to carry into effect the powers granted by the legislature. Such powers may be expressly conferred by the statute or may be implied from the duty imposed upon the city council to protect the lives, health and property of the public. (*City of Chicago* v. *Mandel Bros.*, supra; *Williams* v. *City of Chicago*, supra.) Reasonable regulations for the protection of the lives and the safety of citizens, as well as of property against destruction by fire, are

within the powers delegated to the city and which may be exercised by it. (*Spiegler* v. *City of Chicago,* 216 Ill. 114; *Gundling* v. *City of Chicago,* 176 id. 340.)

A power within the police power of a city may be reasonably exercised, even though such exercise may result in inconvenience or loss to individuals. In this respect individual rights must be subordinate to the higher rights of the public. The power that the State may exercise in this regard is the overruling law of necessity, and is founded upon the maxim, "Salus populi est suprema lex." The existence and exercise of this power are an essential attribute of sovereignty, and the establishment of government presupposes that the individual citizen surrenders all private rights the exercise of which would prove hurtful to the citizens generally. (*City of Chicago* v. *Rogers Park Water Company,* 214 Ill. 212; *Mugler* v. *Kansas,* 123 U. S. 623.) While the general principle above announced is uniformly recognized, it is equally true that the owner of property has the right to make any use of it he desires that does not endanger or threaten the safety, health, comfort or general welfare of the public. Mr. Cooley, in his work on Constitutional Limitations, states the doctrine of the police power thus: "All contracts and all rights, it is held, are subject to this power, and regulations which affect them may not be established by the State, but must also be subject to changes, from time to time, with reference to the well-being of the community, as circumstances change or as experience demonstrates the necessity. (Cooley's Const. Lim. 57.)

The police power is the power of the State co-extensive with self-protection, and has been termed, not inaptly, "the law of overruling necessity." Such power is not prohibited by that clause of the Constitution of the United States which forbids the passage of laws impairing the obligation of contracts. (*Town of Lake View* v. *Rose Hill Cemetery Company,* 70 Ill. 191.) Whether or not an ordinance is the proper exercise of police power is a judicial question. Is this ordinance a proper exercise of police power? We approach this question under the presumption of law that the ordinance is valid, and the rule of law places upon the party attacking an ordinance as an unreasonable or oppressive exercise of the police power the burden to affirmatively and clearly show where the unreasonableness exists. (*People* v. *Village of Oak Park,* 266 Ill. 365.) Where two constructions are possible, one which will sustain the ordinance and the other which will defeat it, the court will adopt the construction sustaining the ordinance. (*City of Chicago* v. *Oak Park Elevated Railroad Company,* 261 Ill. 478; *City of Benton* v. *Blake,* 263 id. 358.)

The ordinance in question provides for the installation in buildings of the character of that of appellant of a sprinkler system, of which the evidence shows there are a number of approved makes on the market, and the plan for the installation of a sprinkler system must be submitted to and approved by the chief of the bureau of fire prevention and public safety. Counsel for appellant urge that this provision is invalid, for the reason that it gives arbitrary power to an officer of the city. We do not so view it. The chief of the bureau of fire prevention and public safety is given power to approve the plan of installation only. He has nothing whatever to say with regard to what system shall be installed. Section 18 of the ordinance provides as follows: "The owner or owners of all such buildings shall submit plans for approval to the chief of fire prevention and public safety for such proposed sprinkler system, showing the size, capacity and location of all sprinkler heads, pumps, tanks or pipes, and any other apparatus which is to be used in connection with such sprinkler system. * * * Said plans, when approved, shall be stamped by him to that effect before such system shall be installed."

The question of approval of plans by an officer of a municipality was passed upon in the case of *Arms* v. *Ayer,* 192 Ill. 601, the question therein arising under the Fire-escape Act of 1897. That act provides that the "number, locality, material and construction of such escapes shall be approved by the inspector of factories." This court in that case said: "The first objection made to the statute by counsel for appellees is that it imposes legislative power upon the inspector of factories, in that it authorizes him to determine how many, and in what position, fire-escapes shall be placed, etc. It must be admitted that the act is loosely drawn, but the rule that it is the duty of courts to so construe statutes

as to uphold their constitutionality and validity, if it can be reasonably done, is so well established that the citation of authorities is needless. In other words, if the proper construction of a statute is doubtful, courts must resolve the doubt in favor of the validity of the law. Statutes and city ordinances provided for fire-escapes are usually somewhat general in their enactments, and necessarily so, for the reason that it is impossible for the legislature to describe in detail how many fire-escapes shall be provided, how they shall be constructed and where they shall be located in order to serve the purpose of protecting the lives of occupants, in view of the varied location, construction and surroundings of buildings; and hence, so far as we have been able to ascertain, acts similar to the first section of this statute have been sustained in other States, though perhaps the question here raised has never been directly presented. (*Rose* v. *King,* 49 Ohio St. 213; *Willy* v. *Mulledy,* 78 N. Y. 310; *Pauley* v. *Steam Gauge and Lantern Company,* 15 L. R. A. 194; *Schott* v. *Harvey,* 105 Pa. St. 222; *Orin* v. *Steinkamp,* 54 Ohio St. 284; *Sewell* v. *Moore,* 166 Pa. St. 570; *Keely* v. *O'Connor,* 106 id. 321; 2 Pa. Dist. Rep. 623.) The general rule is that a statute must be complete when it leaves the legislature—as to what the law is—leaving its execution to be vested in third parties. Thus, it was said in *Dowling* v. *Lancashire Ins. Co.* 92 Wis. 63: "The result of all cases on this subject is, that a law must be complete in all its terms and provisions when it leaves the legislative branch of the government, and nothing must be left to the judgment of the electors or other appointee or delegate of the legislature, so that in form and substance it is a law in all its details *in presenti,* but which may be left to take effect *in futuro,* if necessary, upon the ascertainment of any prescribed fact or event." And it is said in Sutherland on Statutory Construction (sec. 68): "The true distinction is between a delegation of power to make the law, which involves a discretion as to what the law shall be, and conferring an authority or discretion as to its execution, to be exercised under and in pursuance of the law. The first cannot be done; to the latter no objection can be made." In *People* v. *Reynolds,* 5 Gilm. 1, it was held that to establish the principle that whatever the legislature may do it shall do in every detail or else it shall go undone, would be almost to destroy the government. It is there said (p. 13): "Necessarily, regarding many things especially affecting local or individual interests, the legislature may act either mediately or immediately. We see, then, that while the legislature may not divest itself of its proper functions or delegate its general legislative authority, it may still authorize others to do those things which it might properly yet cannot understandingly or advantageously do itself. Without this power legislation would become oppressive and yet imbecile." Concerning the objection that the ordinance confers judicial powers on an officer of the city, this court further said in the *Arms* case: "Of still less force is the objection that the act confers judicial power upon the inspector of factories. The inspector is given no power to judicially determine any question, but acts ministerially in the supervision of the building of fire-escapes. Judicial power is 'the power which adjudicates upon and protects the rights and interests of individual citizens, and to that end construes and applies the law.' The judicial power is never extended to cases of the exercise of judgment in the execution of a ministerial power. *Owners of Lands* v. *People,* 113 Ill. 296."

In the case of *Spiegler* v. *City of Chicago, supra,* where it was sought to enjoin the enforcement of what was known as the "Drip-pan ordinance," which ordinance required that the drip-pans or devices used by auto vehicles shall be subject to the approval of the commissioner of public works, this court said: "The power to legislate is not conferred by said ordinance upon the commissioner of public works, but he is only given power to approve the drip-pans or other devices with which said 'tank wagons or other wagons or vehicles' are equipped. The power thus conferred upon the commissioner of public works pertains solely to the execution of the ordinance and not to the passage thereof."

The ordinance in question is not subject to the objection urged. The sprinkler apparatus is designed to prevent the spreading of fire and to put out fires in their incipient stages, and the testimony in this record tends to establish that they are efficient in so doing. Any regulation which tends to lessen the damage and dangers of fire and prevent the spreading thereof in densely populated cities is one which tends toward the protection of life and property of

the public, and is therefore, unless oppressive and unreasonable, a proper exercise of police power. The ordinance in question is not shown by the record to be oppressive in its application to appellant. It owns and is possessed of valuable property at the corner of Madison and Ogden avenues, in the City of Chicago. This, the evidence shows, is a populous section of the city. The building is occupied by patients suffering from the effects of alcohol, making it necessary to have a large portion of the windows barred with iron grates. The evidence also shows that windows to the fire-escapes are thus grated and are padlocked. The nature of the ailment of the patients in this building is such as to make them at times unruly and difficult to handle. Especially would this appear to be true in the case of fire. The cost of the installation of this system in appellant's property is shown to be about $5500, while the value of the property is shown by the record to be considerably over $200,000. The record also shows that a saving in insurance premiums owing to the installation of a sprinkler system would pay the expense of such system in approximately thirty years. Considering these facts, together with the fact that such system is a protection to the property of appellant, it becomes apparent that such requirement is not oppressive. The ordinance is general in its application. It applies to all buildings coming within the character of the one described by its terms, and therefore cannot be said to be discriminatory.

It is also contended that the ordinance is void on the ground that it violates the Federal Constitution. That which is recognized by the State as within the police power of the State is so recognized by the Supreme Court of the United States. *Cusack Company* v. *City of Chicago,* 242 U. S. 526.

We are of the opinion that the ordinance in question was a reasonable exercise of the police power delegated to the city council and that it did not violate the State or Federal constitution. The judgment of the Municipal Court will therefore be affirmed.

Judgment affirmed.

Aviation and Fire Protection.

By W. T. Colyer,

(Member N. F. P. A.)

Although aviation for civil and commercial purposes is still in the experimental stage, it is clear that the development of aerial traffic will present new and varied problems for solution by the fire protection engineer. Like every other advance towards the mastery of nature, it will be attended by mishaps, of which the Chicago "blimp" disaster of July last has already given us a foretaste. The problem is how to reduce these mishaps to a minimum. Already the accident hazards of flight are receiving attention from safety engineers, and physicians are interesting themselves in its effects upon the human organism, particularly the heart. At the June meeting of the Executive Committee of the National Fire Protection Association the question of the appointment of a special committee to consider aerial fire protection was discussed, but no action was taken. Perhaps it was felt that many of the prophesies that have been so freely made regarding the coming popularisation of the airplane and the "blimp" for all sorts of purposes had their origin in the imaginations of journalists rather than in the sober calculations of practical business men. This view is, to the writer's knowledge, still held in some well-informed quarters. Nevertheless the press notices and other publicity material bearing on the commercial development of aviation show no falling off; and in view of the amazingly rapid changes

wrought under the stress of war, there is nothing inherently unreasonable in supposing that the adaptations necessary to make aircraft suitable for commercial transportation may be effected in a comparatively short time. As soon as the process of adaptation begins in earnest, there can be no question as to the desirability of prompt and active interest on the part of fire protection engineers. It may happen that the methods of design and construction which will most obviously promote cheapness and comfort of travel will be open to grave objections from the viewpoint of fire hazard. In that event it would probably be vastly easier to secure modifications during the early experimental stages than it would be to devise safeguards for dangerous machines which had been developed at great cost.

What is attempted here is the assembling, for the information of the fire prevention fraternity, of data illustrating what other men are thinking and doing about commercial aviation. The uses to which aircraft are already being put are more numerous than is generally realized. Everyone is familiar with the overland routes established in connection with the U. S. Postal Service, and wide publicity has been given to the experiment that was recently made in the dispatch of late mail by airplane to overtake Atlantic liners that had already sailed. It is probably not so well known, however, that a prominent shipping firm has ordered planes for the purpose of obtaining and delivering ships' papers before arrival and after sailing, thus speeding up the "turn around" which is giving rise to so much concern in shipping circles just now; that the Conservation Commission of New York State is to use aircraft for photographic and map-making work in the Catskill Mountains; that seaplanes are to accompany fishing fleets from Gloucester, Mass., for the purpose of finding schools of fish; that investigations are under way as to the most suitable among the smaller types of plane for inspection and repair work on electrical power lines at inaccessible points; that a physician in Nebraska is using an airplane to make professional calls in towns at a distance from his home; that these appliances are receiving serious consideration as means of facilitating the work of ranch and plantation managers and for rounding up cattle; that the establishment of an air police service is being talked of in New York State; that in the not very distant future there is likely to be a fleet of Government airplanes reporting to the Weather Bureau on conditions in various strata of the atmosphere in the same way as investigators now report on land and sea conditions; that big game hunters are looking into the merits of the airplane in connection with their sport; that a taxicab company of Chicago has purchased ten planes with which to establish an "airplane taxi service" which is operated from an airdrome to which the customer is taken from his home by one of the company's automobiles; that the transportation of baseball teams by aircraft is planned with a view to saving time and avoiding night travel. In comparison with these new or projected uses, the establishment of airplane forest fire patrols, now a well-established and rapidly extending practice, seems quite commonplace. About two years ago Chief Louis Almgren, of San Diego, had a hydroplane in service for the purpose of checking waterfront fires. The plane was equipped with soda-and-acid

and special liquid extinguishers, and, as a result of the high speed of air travel, these could often be brought into operation before the fire had gained much headway. Other features of special value were the adaptability of the plane for assisting in the extinguishment of fires in fishing and pleasure boats where the water was too shallow for a fire tug to be of service, and its use for inspections of lumber yards and other occupancies along the waterfront. As readers of the QUARTERLY (January, 1918, p. 251) will remember, the Chief laid particular stress upon the last-mentioned matter, and in this connection it is worth noting that at an altitude of 500 feet it is considered possible to conduct an efficient inspection of electrical power lines, even though travelling at considerable speed. We have the authority of Edward Rice Doyle (recently Radio Officer in the U. S. Air Service), writing in the *Electrical Review*, for the statement that at that altitude the eye can take in details of the line without difficulty, and that, by reason of his point of vantage, the observer has plenty of time to look over any critical spot before it gets out of sight.

In addition, a considerable number of planes are owned by individuals for pleasure and sport. According to the United Aircraft Engineering Corporation, there are on the market today, at the price of $2,500, planes capable of carrying one, two or three people, and the cost of operating such a machine is about 18 cents per mile for gas, oil, repairs and depreciation. From the same source we obtain some other interesting figures. Omitting depreciation and insurance charges, the U. S. Mail Service records show that from May 15, 1918, to May 1, 1919, the average cost per mile between New York and Washington was $1.21 for planes capable of carrying 600 pounds of mail, 81 cents for planes carrying 400 pounds, and 79 cents for planes carrying 350 pounds. This cost includes gas, oil, office force, rent, pilot's and mechanic's wages, repairs, interest on investment, post-office department overhead, and motorcycles and trucks.

When we look abroad we find similar phenomena. On August 25th, 1919, a daily airplane service was established between London and Paris. The machines used on this route accommodate not less than four passengers, carry parcels and letters at special rates, and accomplish the trip in less than two and a half hours. Evening newspapers are carried from London to the east coast of England every day by airplane. In a commerce report dated June 12th, 1919, mention was made of arrangements for daily flights from London into Scotland. A change of machine was to be made at Harrogate, in Yorkshire, and the planes were to carry from four to ten passengers. It was planned in connection with this service to place London evening newspapers on sale in Harrogate on the day of publication. Postal matter is being delivered by Chilean pilots in Santiago and Valparaiso. In South Africa fast air mail service between the big cities, such as Cape Town, Johannesburg, Durban, Port Elizabeth, etc., is under consideration, and the possibilities of aerial transportation for passengers as well as mail to the more remote centers (including the establishment of airdromes and gasolene stations in the desert) are receiving attention.

Last year a Committee on Civil Aerial Transport reported to the

British Air Council on the steps to be taken for the development and regulation of aviation for civil and commercial purposes from the domestic, imperial and international standpoints. Among its recommendations was a change in the law under which the owner of a plot of land on earth is supposed also to own the space for an indefinite distance heavenward. It was the Committee's opinion that no action for trespass should lie against passing aeronauts except for material damage.

The details of the program of the first International Aeronautical Exposition arranged to be held in Amsterdam in August last under the auspices of the Chambers of Commerce of Amsterdam and Rotterdam, and the Secretaries of the Interior, War, Agriculture and Commerce, and Waterways, the Governor of the Province of North Holland and the Chairman of the Royal Dutch Association for Aircraft will also give an idea of the broad way in which the industries affected are studying the problems of aviation. We quote from a statement published in the *Water and Gas Review* shortly before the date of the Exposition:

Especial attention will be devoted to exhibits of means for facilitating transportation by air for commercial purposes. The exposition will cover all aids to air transportation, its different parts and elements, and necessary articles. Exhibits of aircraft designed primarily for military use are excluded.

Examples of planes for the use of post offices, police patrol planes, observation planes for geographical surveys, and excursion planes will be made. The motor industry will be well represented, and its exhibit will include ordinary and special automobiles designed for use in connection with air transportation.

Special branches of industry will be represented by:

Instruments, such as trip recorders, altimeters, air speed meters, compasses, inclinometers, manometers, thermometers, etc.

Apparatus for aerial photography.

Instruments for wireless telegraphy.

Ways and means for lighting aeroplanes and landing fields.

Triplex and other glasses, binoculars, etc.

Tanks, wire, cables, turnbuckles, fittings, ball bearings, propellers.

Carburetors and magnetoes.

Flying suits, heating devices and light baggage.

Auxiliary materials.

The exposition will be divided into 17 groups, as follows:

1. Historical group.
2. Land planes.
3. Hydroplanes.
4. Motors.
5. Automobiles and motorcycles.
6. Aeroplane construction, tools and accessories.
7. Photography, maps and literature.
8. Telegraphy, telephony.
9. Generators and lighting.
10. Instruments.
11. Meteorology.
12. Experimental planes.
13. Medical division.
14. Clothing, equipment and heating appliances.
15. Scientific group.
16. Navy.
17. Army.

An opportunity will also be given to the public to see "the birds in their flight." For this purpose there will be various demonstrations, such as:

The ascending of different types of planes.

The keeping of a regular air service to foreign countries.

The opportunity to make flights.

Night flights accompanied by searchlights.
Air acrobatics in its most spectacular form.
If possible, also contests.
In conclusion, lectures will be held on air transportation, the building of aeroplanes, the aerodynamics, the meteorology, the materials, aerial photography, wireless telegraphy and telephony, etc., and moving pictures of aeroplanes in their flights will be shown.

As designed today, airplanes carry "useful loads" of from 20 to 40 per cent. of their gross weight, the useful load comprising the weight of the crew, fuel, oil and cargo. The gross weights of airplanes are stated to vary from 500 to 35,000 pounds. "N C" seaplanes have a gross weight of about 22,000 pounds and carry a useful load of about 35 per cent. The carrying capacity of an air ship depends on its displacement. About 1,000 cubic feet of hydrogen will lift 70 lbs.; helium, a non-flammable gas, will lift slightly less. The ratio of useful load to gross weight in this class varies from 30 to 60 per cent.

The foregoing facts and figures are cited as evidence that aviation is rapidly becoming a factor in everyday life, and therefore worthy the immediate attention of the fire protection engineer. Some of the ways in which he may be of service have been indicated by disasters that have already passed into history. It is evident, for example, that the use of inflammable gases for air ships constitutes a severe hazard. Whatever may have been the cause of the Chicago disaster, it is at least clear that the conditions under which the "blimp" was operated presented several well-defined hazards. In that case, it will be remembered, the blazing air ship crashed in flames through the roof of a bank, bringing mutilation and death to many occupants of the building, as well as to those who were on board. At least one non-flammable gas, helium, has been proved suitable as a substitute for hydrogen, and further experiments along the same line should be encouraged.

Some recent developments in air ship construction, also, may give the fire protection engineer considerable anxiety later on. We quote from the *American Lumberman* of August 23rd, 1919:

New Aeronautic Use of Wood.

A well-known British firm has taken out a patent for a new design of rigid airship hull. A gas-tight shell is to be made up of several layers of wood veneer with fabric layers between, the whole cemented and stitched with fine copper wire, and with interior longitudinal and transverse bracing. The outer shell gives the structure its chief strength and also acts as gas container. All the machinery and crew are carried inside the hull, there being no outside projections except the necessary fins and rudders for navigation.

Another valuable feature is that such a hull is unsinkable and therefore safe for ocean traffic. In the relation of weight to strength and carrying capacity, it offers material advantages over former methods of airplane construction.

In the not very distant future the problem of permissible routes will have to be faced, and on that matter, too, the fire protection engineer should have something to say. A short time before the Chicago horror the exploding gasoline tank of a falling airplane set fire to a shingle roof in an eastern city; and if, as Alexander Graham Bell, of telephone fame, predicts, we are to have trains or fleets of dirigible cars drawn through the air by one machine equipped with motor power, this problem will be

rendered more serious by the probabilities of fire ensuing when collisions occur.

Then, too, there are the problems of location and lay-out of airdromes. Probably a good many N. F. P. A. members are not aware that already an engineering corporation is offering to design and construct airdromes, including hangars, power houses, gasolene and oil stations, repair shops, radio and signal stations, meteorological stations, and grandstands for airships and either land or sea planes, or both. Probably hotel or club accommodations will not be long in taking their place as necessary adjuncts to airdromes, particularly such as may be established among the Rocky Mountains or near the Grand Canyon in Arizona—to quote likely spots. It is fairly safe to predict that, unless full weight is given to considerations of fire prevention and protection when such airdromes are planned, a number of serious fires will occur on these properties. Airdromes in the vicinity or suburbs of large cities may also give rise to grave problems. Located, as they probably will be, just outside the areas in which building is strictly regulated, they may in time be surrounded by combustible structures and come to present conflagration hazards.

There are also such hazards as that of the "dope" used for coating the wings of planes. In his comprehensive account of the hazards of airplane manufacture, published in the QUARTERLY for April last, Mr. W. D. Milne stated that it was doubtful whether the extremely inflammable nitrate dope which was used on training planes during the war would henceforth be used at all. Information is not available as to the proportion of planes now in use or on the market which have their wings treated with the hazardous dope, but in any case it appears that cases of industrial poisoning have given a great deal of trouble in connection with the manufacture of dope of various kinds, and that the processes are constantly changed with a view to overcoming this hazard. Is it not possible that, if these changes are not carefully watched, some new fire hazard may creep in while the poisoning hazard is being eliminated? As, presumably, commercial aircraft will carry heating and lighting systems, everything in the construction which tends to increase the fire hazard will be of the utmost importance. Incidentally, standards will probably have to be made to take care of the specialized lighting and heating devices which will almost certainly be developed in this connection.

It is true that of the recorded accidents to airplanes comparatively few have been attributed to fire. In a list of 295 accidents occurring in 1918, only 15, or about 5 per cent., appeared under the headings "fire" and "crash and fire." By far the largest proportion—101, or 34 per cent.—were caused by "tail spin," collisions coming second with 54, or 18 per cent. When to these are added 43 "nose dive" accidents, making a total of 198 from these three special causes, it will be seen the 15 fires are quite an important item in the remaining 97 accidents. It is understood that "tail spin" and "nose dive" accidents are largely the result of inexperience and defective machines, and these two classes are likely to be greatly reduced as commercial aviation progresses. With the increasing capacity of the aircraft the possible consequences of each

individual fire will become more serious, thus increasing the emphasis to be laid on fire prevention and protection as a feature of successful aviation.

Fire protection in the air is already receiving some attention in the technical journals. In a recent issue of *The Aircraft Journal* research work looking to the development of satisfactory fire-resistive "dopes" was commended; and reference was made to the possibility of filling the entire engine section of a machine with fire extinguishing gases simply by pressing a switch. Screens on carburetors for the purpose of preventing backfiring, and "smoke-stacks" to carry any flame from exhaust pipes clear of machines were also advocated as essential to fire safety.

Another angle from which the fire preventionist may have to approach this subject was indicated in Mr. A. R. Small's speech at the Ottawa Convention in May, in which he referred to the possibility of large plants being equipped with facilities for shipping and receiving goods by air ship within the next ten years. Such a development might involve a new treatment of the problems of vertical openings, of the storage and handling of inflammable liquids, and perhaps of other matters under the jurisdiction of existing N. F. P. A. Committees.

It may be that "watchful waiting" is the only feasible policy for the fire preventionist in the matter at the present time, but in view of what has already been said, it would seem that at least as much emphasis should be placed upon the importance of being watchful as upon the need for waiting.

Kerosene Lamp Explosions.*

By C. E. Worthington,
(Member N. F. P. A.)

Courtesy Safety Engineering.

Kerosene lamps explode. At least such is the popular tradition and conviction, based upon extensive evidence, credible and incredible—mostly incredible—but, on the whole, too profuse to be wholly discredited. So we may assume the fact. If, however, we accept what we ordinarily understand an explosion to mean, viz., the disintegration and expansive conversion of all or a part of the contents of a receptacle and its forcible disruption, thereby destroying instantaneously the receptacle and scattering any remnant of its contents broadcast and without warning, actual lamp explosions are extremely rare. Kerosene does not explode; it cannot be exploded by concussion, detonation or application of fire so long as it remains a liquid. Explosion is simply extremely rapid combustion, an operation requiring the distributed presence of large volumes of oxygen, and kerosene contains no oxygen whatever. The vapor of kerosene, which is merely kerosene very finely divided, when evenly mixed with air (which is largely composed of oxygen) will explode violently for the same reason.

Hence it is possible to explode a lamp or other receptacle containing kerosene under certain conditions; but there are several conditions to be fulfilled. The several must be present and act concurrently, and they are all fairly well guarded against; and although one or even two of the requisite conditions may exist simultaneously, it is not sufficient unless all are coincidently present. What generally passes in common parlance as a lamp explosion would more properly be termed a "flare." In this case the flame seems to gain suddenly and emit smoke; then follow the breaking of the chimney and considerable yellow flame, with much dense black smoke, which has the effect by reflection of making the blaze appear much larger than it really is. Wherever this smoke condenses it leaves a thick deposit of oily, unconsumed carbon, or "lampblack."

Ordinarily, if let alone, this will burn itself out without any special injury to the lamp beyond the distortion of the metal burner parts, but the appearance is far too threatening and the damage inflicted by the smoke usually too great for considering such a course. There is also a chance of fire damage from breaking of the lamp by heat, which would permit the oil to escape and ignite (not explode); so an attempt is at once made to remove the lamp to some place where neither smoke nor burning oil will be dangerous. It takes much courage and good nerves to attempt to remove the lamp with the threatening blaze, especially if one is previously impressed with the idea of imminent explosion; and

*This article is issued in pamphlet form by *Safety Engineering.*

there is a little real danger that in moving it the flame may be blown against the lamp and crack it, letting oil run out and ignite. So usually the operation of removal, which should be done with care and deliberation, is done in haste and trepidation, resulting often in overturning, dropping or breaking the lamp with more or less serious results. This is not explosion, but about all of the "explosions" reported in the press turn out on investigation to have been really flares. The flare is bad enough, and there must exist some good reasons for its occurrance (as well as for the actual explosion which comes sometimes), either in the construction of the lamp or its care, and some palliatives if not complete remedies.

Kerosene.

A little preliminary understanding of what kerosene is and of its qualities is necessary at the outset. Kerosene is the name applied to the illuminating oil content of petroleum. It must not be confused with coal oil, which is an entirely different product, derived from the destructive distillation of certain shales. Coal oil is similar to kerosene in many respects, but quite dissimilar in others; and is not now, and has not been for many years past, a commercial product to any appreciable extent. It would be a matter of great difficulty, if possible, to purchase even one gallon of coal oil; so for present purposes that material may be wholly disregarded.*

Kerosene is produced from petroleum by distillation under heat and pressure, which break up or "crack" the petroleum. The lighter products first drawn off and condensed are extremely volatile and also very combustible. Rhigolene, or petroleum ether, the lightest of these, will boil from the heat of the hand, but the next grades, known as gasolene or naphtha, are more familiar. All are volatile and give off at very low temperatures vapors that become explosive when mixed with air. These vapors are nearly three times as heavy as air and do not very readily mix with air. They are highly explosive when mixed with about 2.5 per cent. of their volume of air, and the explosibility ceases before 9 per cent. admixture is reached.

The next lot of vapors to come over are condensed into illuminating oil. This oil is heated with acid to remove certain impurities, the acid remaining is neutralized by use of alkalies and the product thoroughly washed. The nearly colorless oil procured by this process is known as kerosene. This is a comparatively modern product, produced commercially for the first time by the United States Chemical Manufacturing Company in Waltham, Mass., about 1851. It met with little sale for several years, but upon the discovery of oil in Pennsylvania its production was cheapened and its use extended rapidly. Before this coal oil was used to some extent, although in some disfavor because of what was termed "explosibility"; also camphene (a strict synonym for spirits of turpentine), and "burning fluid," which was a 50 per cent. compound of camphene and grain alcohol, all of which followed candles, sperm oil and lard oil for illuminants. Many persons now barely past middle age can doubtless recall to some extent the use of all of these.

*NOTE: In some districts the name coal oil still persists and is used almost exclusively as applied to illuminating oil instead of kerosene.

Kerosene is a very complex substance. Chemically it is a hydrocarbon oil and chiefly composed of hydrogen and carbon, but it contains no free oxygen. The carbon, however, is not a single form, but a considerable variety of forms, some uniting readily with oxygen, some requiring extremely high heat for such union. These "non-volatile carbons" are not present in any large volume, but, as we shall see later, the small proportion that does exist is material to the hazards of use.

All substances when heated to a certain point give off vapors, that is to say, they begin to break up and throw off superficially very minute atoms of their substance, both gaseous and solid. This, in general, is near the boiling point, but in what are termed "volatiles" it is much below—sometimes far below any ascertained natural temperature. Many naphthas, for instance, give off these vapors in dangerous quantities at —40° F. The point at which the vapors, if brought in contact with flame, will flash back and ignite the main substance is called the flash-point. This is well within control of the manufacturer of illuminating oils, and there is a rule of legislation determining the point at which they can be legally sold. Generally the "legal test" or flash-point of kerosene is between 100° and 105° F., usually the former; that is, the fluid must be warmed to that point before giving off explosive vapors in dangerous volume. Vapor is given off at lower temperatures, but so slowly that no dangerous accumulation ordinarily occurs. A small confined space may be filled, but if once ventilated considerable time is required to renew it, and very slight ventilation suffices.

The vapor of kerosene is, to all practical intents and purposes, identical with naphtha vapor, having about the same explosive qualities, with about the same admixtures of air, only differing substantially in the temperature required to produce it.

Kerosene in bulk burns in the air superficially and only by the conversion of the surface to vapor. It burns in a mass with a dull yellow flame, much dense black smoke (unconsumed carbon—lampblack) and comparatively little heat. When vaporized or sprayed, so as to insure a sufficient supply of oxygen, it burns with a pale blue flame with little light and high heat. As used directly for illuminating purposes, the supply of oxygen must be so regulated as to heat the carbon particles white hot, but not destroy them, since it is simply from the incandescence of these particles (given off as lampblack in the instance first quoted) that light is obtained. Thus, in indirect proportion to the oxygen mixture and heat of combustion, the flame is dull yellow (little light), bright yellow (fair light—ordinary), white (maximum obtainable), pale blue (complete combustion—little light). This will serve to explain the differing results obtained by different burners from the same oil.

The Theory of the Lamp.

All portable apparatus burning kerosene oil for illuminating purposes is based upon the proposition of bringing the oil continuously in small quantity to the point of combustion and vaporizing it at that point, at the same time supplying, generally by a forced or induced draft, exactly enough air to produce the maximum heat of combustion possible without

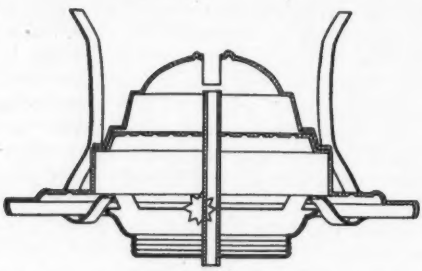


Fig. 1. Bisected burner (open) showing cup about base of tube.

destroying the carbon particles. If the flame is too hot or not hot enough the result is similar, but the light is diminished.

Types of Burners.

These may be divided into four general classes: Flat wick, round wick, tubular wick and pressure burners. The last-named system for portable lights is practically obsolete and need not be discussed here, although sometimes found in use for stationary apparatus on a large scale for lighting stores and factories. These "pressure systems" operate generally on the plan of complete combustion, obtaining light by means of incandescent mantles, and oil is generally distributed by compressed air pressure from a tank or reservoir, more rarely by gravity, the general operation being upon the same principle as that of the "blue flame," wickless kerosene stove.

Flat Wick Burners.

This is the type most frequently found in common or household use, and its construction in the commoner and cheaper forms is well shown in Fig. 1, showing a bisected burner of this class taken from a lamp that flared, or, as reported in the daily papers, "exploded." (See also Fig. 2.) This is made of sheet brass, and the general plan is quite simple, consisting primarily of a saucer-like base threaded to screw into a socket attached to the font, or oil receptacle, through which extends a flat tube for the passage of the wick. This tube, ordinarily about 1½ inches long, extends slightly below the bottom of the "saucer." Approximately an inch above this is a second "saucer," this time inverted and having the bottom and outer rim coarsely perforated (the bottom is, of course, the top when in an inverted position). The edges of this "saucer" extend slightly below the top of the lower one, the difference in diameter affording an open space of about one-quarter of an inch. This also fits closely to the wick tube.

In the space between the two "saucers" the wick tube is slotted in two places to permit the entrance of two small spurred wheels on a stem, the revolving of which operates to raise or lower the wick, the slots exposing the wick. (It is from ignition of the exposed wick at this point that the most trouble comes.) From the edge of the bottom saucer

Figs. 2 and 3. Burner of ordinary type, closed and open respectively.

there generally extend four spring arms to hold the chimney in position, curving outward and upward. Upon the upper "saucer" and just exceeding the perforated plate in diameter is superimposed a curved metal cap, frequently hinged, slotted above the wick tube, the slot being just a little larger than the tube and perhaps two-sixteenths of an inch above it.

The function of the wick is, of course, to take up the oil continuously by capillary attraction, that unexplained force which causes fluids to rise in small tubes or spaces against gravity.

The space about the lower "saucer" is to permit free entrance of air; the upper plate is perforated to permit air to pass through it freely and yet, to some extent at least, to shield the lower saucer from accumulations of dust and drippings.

The function of the curved cap is to concentrate the air supply at the point just above the end of the wick, the underlying idea being to provide a point of ignition just far enough above the wick to heat the upcoming oil to the point of vaporization and yet far enough away to avoid consuming the wick. To do this exactly is, of course, impracticable, but all burners approximate it. The upward draft is induced by means of a chimney, usually of glass, with a straight tubular base to fit between the spring arms, and often bulging opposite the flame to avoid cracking from heat. These chimneys vary greatly in shape, according to the whims of the maker.

When a match is applied to the top of the wick and held there long enough to vaporize a little of the oil, it ignites and burns with a yellow flame and much smoke, but upon placing the chimney in position and increasing the air supply the flame becomes clearer and nearly smokeless. The draft increases as the chimney heats, generally calling for some regulation of the wick soon after lighting. With a clean lamp and properly trimmed wick there is practically no fire hazard so long as the lamp itself remains intact and the height of the wick is properly regulated.

The Fire and "Explosion" Hazard.

Apart from leaving or placing a lamp where it may be easily overturned or broken, the hazards may be completely summed up in two

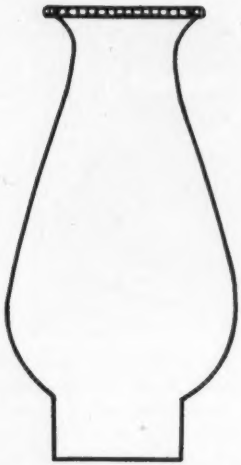


Fig. 4. Typical lamp chimney.

terms: (1) carelessness and neglect of cleaning and trimming; (2) the not uncommon practice of keeping lamps where the temperature is above the normal—for instance, on a shelf back of and above the kitchen range or cook stove.

Kerosene of legal test of 100° F. begins to give off explosive vapor in considerable volume when heated to that point. The average temperature of an ordinary room may be set at 70° F., so that the hazard of vaporization begins to be serious at a point only 30° above the normal. When the lamp is lighted the chimney and burner are speedily heated, and the whole body of the lamp, contents included, is slowly heated by conduction. So, in any event, in a lamp that has been burning for some time the temperature is above the normal, and a good deal depends upon the starting point of this increase. If a lamp of 70° temperature will heat to 85° in four hours, it is clear that if the same increase applies to a lamp of 90° temperature the danger point will be passed within that period. The slow heating of the lamp is inevitable. Of course, the burner heats more rapidly than the lamp.

By examining the cuts it will be readily seen that the projection of the rim of the inverted "saucer" below the top of the lower one makes the interior and bottom of the lower entirely invisible from any angle of vision. Possibly this projection was intended to serve to some extent as a shield from dust, but its main function is sightliness, concealment of the unsightly "saucer" and slotted wick tube, since dust is freely drawn in about the open edge.

The perforated plate does some duty as a fire guard as long as it is cool enough, but the perforations are coarse, and when the plate is heated it affords but a slight barrier (even fine gauze ceases to be effective when sufficiently heated); the perforations, moreover, are large enough to permit small pieces of charred wick to pass through.

This "saucer," invisible and uncleanable by ordinary means, serves to collect dust, a process aided by the draft of the flame, charred fragments and more or less oil which necessarily comes through the slots in the wick tube or works down from above. The latter is largely avoidable, the former not.

When there is any material accumulation here—and there usually is in an old or much used lamp—as soon as the temperature reaches 100° in the brass burner explosive vapors are emitted, and if the perforated plate is hot enough, will reach the flame and may flash back; probably under some extreme conditions they pass outside and ignite. The ignition of a very little of this highly combustible accumulation serves to set fire to the exposed wick in the slot (whoever has tried to

turn down a flaring lamp may have noticed that it cannot be done, the reason being expansion and distortion by heat of the stem carrying the spurred wheels). This fire in the "saucer" consumes all, or about all, of the oxygen which should reach the top of the wick, and imperfect combustion, yellow flame and much smoke results; then the chimney cracks and falls away. This is why a lamp left burning for a long period flares, but the same result may be brought about by blowing down the chimney, thus forcing flame through the perforated plate and igniting vapor or material below it, or by a strong draft. The lamp in this deadly quality somewhat resembles a rattlesnake; it customarily gives ample preliminary warning by beginning, in household phraseology, to "smell." Unpleasant odor in a lamp when lighted is *prima facie* evidence of an unclean condition, with a probable location in the "saucer."

There is some hazard about the wick. The object of the burner is to keep the point of highest heat and combustion a little above the top of the wick. Most of the carbon in kerosene after doing duty in the flame passes off in smoke, which is not visible when all goes well, but is there (its presence is readily detected by the dark rings on the ceiling above a permanent lamp or by holding a sheet of glass eight inches or more, to avoid interrupting draft, above the chimney); but some is not vaporized except in a forced draft of air. The result is that during the brief period which must elapse between applying the match and putting on the chimney a little crust is formed on the top of the wick. This requires the turning up of the wick to bring it into proper relative position to the draft, and brings the top near enough to the combustion center to actually char, sufficiently complete combustion being prevented by the deposit mentioned. The higher the wick is turned the more of the sides are exposed, and since the flame is brought into more complete contact with the parts of the burner less affected by the ordinary draft, the more rapidly and completely the burner heats; hence, the complete removal of this "char" before lighting is imperative.

The exact sequence of conditions and events leading up to an actual explosion is a matter of some doubt, but it is certain that low oil and a correspondingly large vapor space are prime factors, since only the vapor is explosive. Further, a certain admixture of air is necessary to produce an explosion, and just how the air enters the font is not always clear. There is a very little space about the wick in the tube, and possibly enough air can filter in, but general observation suggests that the small flat tube often found alongside of the wick tube may be largely responsible. Just what function was contemplated in this tube is hardly clear, certainly not to relieve vapor pressure, for the tensile resistance of a hollow receptacle is too considerable to be overcome by ordinary vaporization. It would, of course, be possible to rupture a font, either of glass or metal, if the contents were sufficiently heated and enough time was given, but the first of these conditions is never present, so ventilation is needless; while there is every reason to suppose that the tube lets in some air, 2 per cent. to 8 per cent. is needed to assure violent explosion if ignited, but unless there is this proportion of air there can be no explosion. This tube cannot in any manner contribute to flares, but if hot enough it might permit the passage of flame to the font.

Tubes, gauze and perforated plates protect by absorbing heat, and when sufficiently heated themselves they entirely cease to function.

The brass bottom of the lower "saucer" and the wick tube which projects slightly into the font are of very thin brass and heat quickly, and it is not merely conceivable but probable that in event of a continued flare they get hot enough to ignite vapor within the lamp when it contains enough air mixture to be ignitable. This, in general, is the most plausible suggestion, but the explosion, when it occurs, destroys all evidence. A loose socket or a cracked font may produce like results, but this is quite improbable.

The flat tube already mentioned is apparently wrong in principle and superfluous. It seemingly is capable of letting in air enough above the oil to produce an explosive mixture and, in case of an overturn of the lamp, provides an unobstructed avenue of outflow for the oil, which appears to be a definite hazard and detriment, while no actually useful function is assignable to it. Statistical information on this point is unobtainable.

The type of burner described above is the one most generally in use; it is the very cheapest form, which perhaps accounts for its prevalence; and since concealment of the danger points is its special feature, it does not externally suggest any trouble in caring for it, which is perhaps another reason.

All flat tube burners do not possess these hazards in the same degree, some being completely cleanable and having the slotted part of the tube tightly enclosed. There are too many variations to illustrate them fully, but several typical forms will serve to show the progression.

It will be noticed, in examining the better forms of burner, that the hazard of accumulation and vaporization of oil, dust, etc., out of sight about the base of the wick tube has been recognized by the burner makers, its elimination attempted, and a style of burner offered in which the space about the slots in the wick tube is entirely closed in, there being no opening internally through which oil and dust can accumulate about the chief danger point. (Figs. 5, 6 and 7.) In this burner air is freely admitted below the perforated plate, which is more finely perforated than in Fig. 1. The perforated plate is, however, difficult to remove and replace, and, although the top of the curved space about the slots is visible, it is still a little difficult to clean. This burner, however, has the needless flat tube, but is a considerably safer one, as it reduces the chances of a flare.

A third typical form is shown in Figs. 8 and 9. This form has the space about the slots in the tube completely closed, and is similar in all respects to Fig. 6, except that the perforated plate is readily removable (and consequently replaceable if injured). The removal of the perforated plate, which simply lifts out by a small handle when the burner cap is thrown back, fully exposes every superficial part of the burner, so that it is easily and completely cleaned. This burner appears to embody the maximum of safety, and it is difficult to conceive how it could possibly originate a flare; the only apparent improvement being the omission of the extra flat tube.

More as an illustration of the numberless variations and devices,

a description is given of the double flat wick burner. (Figs. 10 and 11.) In general details of closure of space about the tube slots, air supply and perforation, this corresponds with Figs. 5, 8 and 9, except that the perforated plate is not removable and there is the same trouble in cleaning as in Fig. 5. The special features of this burner are a cap and chimney support which locks on by a quarter turn, assuring with reasonable care the stability of the chimney, and a device operated by a lever that closes upon the wicks and extinguishes the flame, so that the lamp need never be blown upon to extinguish it. The device is a good one, but since no flame in this case can possibly be blown to a point where it can directly or indirectly ignite the wick in the slots of the tube, it is not of material value beyond convenience. Applied to type 1, it would be a very material safeguard, but it is much too costly to be so applied.

All of the flat wick burners offered for sale fall within the types figured, and the comparative hazards are well shown by these.

Round Burners.

This is the class under which falls the ordinary parlor lamp burner. The wick is a wide flat one and the wick tube a double cylinder, the edges of the wick being bent around to lie closely against a supporting rib which holds the two parts of the wick tube in place. The apparatus is more complicated than the flat wick burner and usually comprises several separable parts. (See Figs. 12 and 13.) This is a fairly typical burner of its class and a reasonably safe one, the space about the slots where the spurred wheels enter being completely closed in and the central space within the inner cylinder of the wick tube likewise sealed. This closure, however, forms a deep well in which large accumulations of oily dust and the like would be sure to occur. The hazard, however, is safeguarded by dropping in an inner sealed tube open at the top and removable; in this case it is a shallow cup on the end of an upright rod. This can be lifted out, bringing with it any accumulations. Severe flares occasionally occur in this type of burner, due probably in every case to ignorance of its construction or to poor care. There is no apparent possibility of a flare except from some accumulations in this central well. It is, on the whole, far less dangerous than the flat wick burner in Fig. 1.

There is another type of round burner in which the central well is closed, but there is no removable cup or plunge provided. This permits considerable accumulation at a point not visible and quite difficult to clean, and, as might be expected, is fairly productive of flares. The type is one to avoid. In general, the round burners belong to one or other of these two types.

Tubular Wick Burners.

This class is practically obsolete, but may be found occasionally; one burner of this sort is offered for sale (no sales recorded) in one of the leading stores, although viewed by them with much distrust. It is in many parts quite complicated, "fearfully and wonderfully made." (See Figs. 14 and 15.) This burner contains the usual central well,

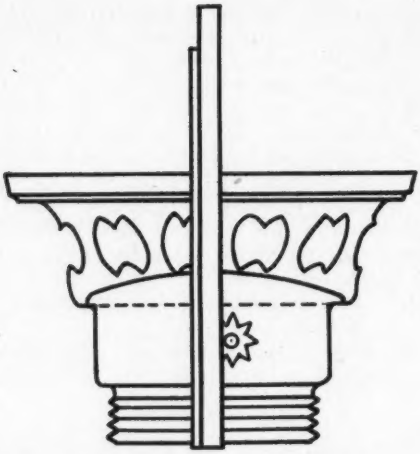


Fig. 5. Cross section showing closure about wick tube.

closed at bottom, but thinly slotted on two sides. The stem passes through this well (it is outside of it in the round burners figured), and the actuating wheel is within it, the spurs engaging perforations in a sliding upright of bent metal, the edges of which pass through the slots and raise or lower a close-fitting collar with small toothed projections. The wick is tubular and placed over the outside of the tube; there is a round hole, seemingly for drainage, in the bottom of the well. There is no safeguard whatever against accumulations in this well unless the perforation will serve to drain off some of the oil; it is hard to examine, requiring the entire apparatus to be first taken apart, and when set up there is *a continuous open space reaching from the flame to the oil* only loosely obstructed by the wick. The device apparently embodies many points of hazard, but is so expensive and complicated that any extensive sale or use is doubtful. For practical purposes it may be ignored, being shown merely to indicate what can be done and sometimes is done.

General Conclusions.

Judging from rather extended personal experience and investigation and all data obtainable, the main causes of trouble are:

(1) *Lack of Cleanliness.* This is chiefly responsible, but is not so much a personal matter as one arising from ignorance of the construction of burners, the nature of kerosene and the use of burners which provide facilities for invisible accumulation and are difficult to clean.

(2) *Carelessness,* such as keeping lamps in warm places, permitting the oil to run low and the like, and careless trimming. Ignorance of fundamental facts and principles, rather than sheer laziness, probably accounts for this in the main.

Fig. 6. Completely cleanable type of burner (closed).

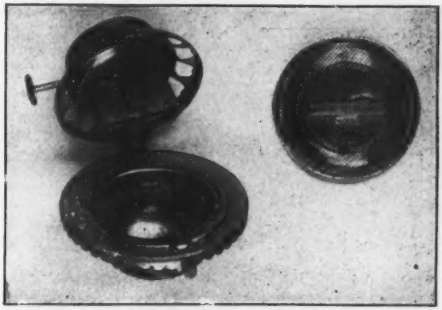
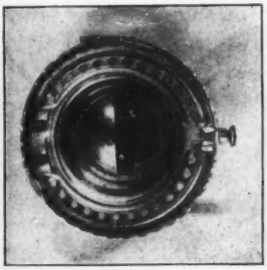
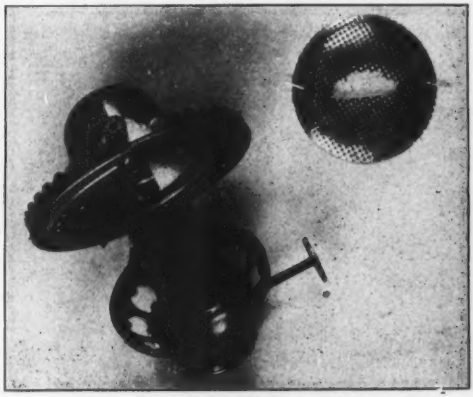


Fig. 7. Same as Fig. 6 (open). Gauze disc removed. Note handle on disc. Tube completely closed in.





Figs. 8 and 9. A better type than Figs. 6 and 7. Shows separable gauze disc.

(3) *Poor choice of burners.* Once more ignorance, and false sense of economy. A safe burner costs a little, a very little, more than a questionably safe one, but to the purchaser a burner is simply a burner, and so long as it will consume oil and produce a light they all seem alike and the cheapest as good as the best. It is to the credit of many shopkeepers that, where they have knowledge themselves, they advise and urge the purchase of safer types, although handicapped by the higher price and the resulting suspicion that their advice is based upon a prospect of greater profit.

Remedies.

The principal remedy is, of course, educational propaganda, but a few suggestions are in order, viz.:

(1) Do not buy and use burners that are hard to clean.

Fig. 10. Double wick burner (closed).

Fig. 12. Round wick type of burner (closed). Parlor lamp.

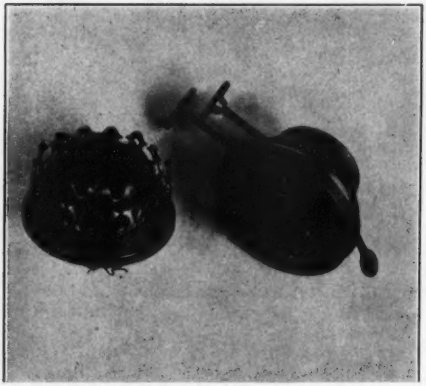


Fig. 11. Double wick burner (open).

Fig. 13. Same as Fig. 12, dissembled. Note cup and plunger for central well (inverted in illustration).

(2) Become familiar with the construction of the burner and its hazardous features.

(3) Keep strictly clean all points where oil and char can accumulate. If a burner of any type begins to give off an unpleasant odor ("to smell"), remove it from the lamp; take out the wick and boil the burner hard for 30 minutes or more in a strong solution of baking or washing soda; shake it about well in the soda and rinse clean in hot water. This should invariably be done in Type 1.

(4) Keep wicks well trimmed, and never let oil get low. If the wick fouls and needs to be turned up high, it is better to extinguish the lamp and trim the wick. A wick in a well kept lamp should last a long time and char but a little at the top. Excessive charring indicates that something is wrong. Obstruction of the perforated plates or enough refuse about the base of the wick tube to produce any considerable volume of vapor will reduce the draft and cause smoking and charring.

(5) If needful to leave a lighted lamp unattended, it is better to use a fresh lamp, one that has not been in use within several hours and is clean throughout, properly trimmed and full. For this purpose a glass font may be preferable, *provided* it is one not easily overturned and it is safely protected from injury.

(6) Do not blow down the chimney in extinguishing a lamp. Blowing down involves serious hazard. Blow across the top, first turning the wick low.

(7) Do not mount bracket lamps in such a position that they can be swung under shelves or curtains or into contact with them. Be certain, in case of suspended or swinging lamps, that they are securely supported by strong incombustible supports arranged to minimize the "swing" of the lamp. (The number of such lamps found supported by string or twine is surprising.)

(8) Do not place or hang lamps in strong drafts.

(9) Keep the wick turned down just below the top of the tube while unlighted.

Glass vs. Metal Lamps.

There are so many points of excellence in glass lamps as compared with metal that it is difficult to condemn them wholly. Glass is transparent, and the level of the oil is always determinable by sight. Glass is a non-conductor of heat, and the increase of temperature in the oil is consequently much retarded — an important feature, since in explosions one of the two determining features is the temperature of the oil. These lamps are also easier to clean than metal.

Their defects are, first, the liability to breakage if upset or struck; this defect has been somewhat exaggerated, since if any lamp is upset oil is likely to run out into the burner, especially if there is an auxiliary open tube in the burner to deliver the escaping oil, directly upon the flame. Glass lamps are subject to another objection, in that the collar or socket into which the burner screws has a tendency to work loose. This is due to the different rates of expansion of glass and metal, and is to some extent unavoidable, although latterly fairly elastic cements have been used that greatly reduce the tendency.

The general difficulty in determining the height of oil and the greater tendency to heat are the unfavorable features of metal lamps. These cannot be overcome.

The ideal lamp is a glass font protected by metal externally to prevent breakage, but a well balanced glass lamp appears to have preponderating desirable features for household use. Tall glass lamps or those on narrow bases or topheavy should never be purchased or used,

Fig. 14. Tubular wick burner (closed).

no matter how much their design appeals to the purchaser's sense of beauty. Safety should take precedence.

The extended use of coal gas, electricity and acetylene has made great inroads upon the popularity of the kerosene lamp, and a further decrease is to be expected, especially if kerosene advances greatly in price. Modern methods of distillation are directed to increased gasolene production and a decreased output of kerosene, which may prove a factor.

It is not at all improbable that the demand for gasolene may result in renewed distillation of shales on a large scale and coal oil again become a commercial product. This would introduce some new problems, which, however, need not be considered at present.

Some Obsolete Types.

Several types of burner distinct in principle from those illustrated have attained considerable popularity at different times. One of these was a metal lamp of hollow construction carrying a flat wick burner. This lamp used no chimney, the necessary draft being forced by a clockwork operated fan in the base. This lamp produced a very white light, probably very close to the maximum light obtainable from kerosene, having from four to five times the lighting power of the ordinary lamp, and using almost twice the oil an ordinary lamp does. The light was sufficiently intense to cause a coal gas flame to throw a quite dense shadow (but from recollection much less intense than acetylene). This was probably the safest lamp ever put into use, but it was fairly expensive and rather heavy. It has not been on sale for many years,

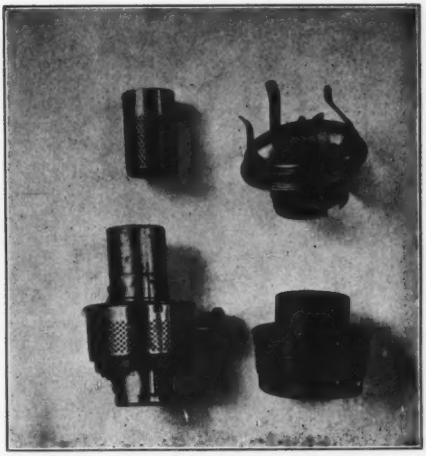


Fig. 15. Tubular wick burner dissembled.

and the patents have probably long since expired. It possesses so many points of excellence that it might be a profitable matter to rediscover it in the Patent Office records and place it once more on the market.

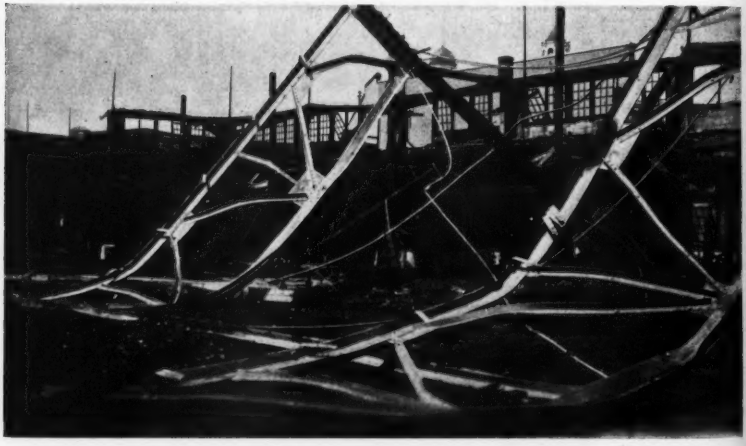
Another is the famous "student lamp," which seems to have gone almost completely out of existence. The fire record of that device was not very good, in fact, considering the comparative number in use, probably worse than any other type of metal lamps. This was a tubular wick device, and it has probably passed forever out of general use.

Incandescent Lamps.

There is another group of devices using kerosene (and gasolene) in which complete combustion of the oil is sought, the oil being converted into vapor, mixed automatically with air and so burned, light being obtained indirectly through incandescent mantles. These devices form a group separate and distinct from those listed here, and they must be considered separately. In all of this the indiscriminate manufacture and sale without restriction of appliances involving fire hazard seems to a great extent to be the basic trouble.

If by some plan factories could be brought under sufficient supervision to regulate the character of their output so far as public safety would seem to require, much good could be accomplished, and there is no apparently good reason or principle against establishing as much of a censorship over fire-producing appliances as over poisonous products.

NOTE. Conditions of care and usage in stores and factories differ materially from those of residences and suggest the superiority of metal fonts where regular skilled attention can be afforded.



Ruins of Waco Cotton Palace after fire, showing failure of unprotected steel trusses.

Waco Cotton Palace Fire.

We are indebted to Member Herbert H. Sutton for the accompanying picture of the ruins of the Waco Cotton Palace after a fire which occurred on April 8, 1919. The fire lasted for four hours and forty-five minutes, and nine lines of hose were used in its extinguishment.

The construction was reinforced concrete columns and girders with hollow tile filler walls; floors, wood; roof, composition on 1-inch wood boards on unprotected steel trusses on wooden posts. The building was one equal to two stories in height.

During the progress of the main fire one pumping engine was used in the extinguishment of *fifteen* subsidiary fires on wooden shingle roofs of residences within a radius of ten blocks. A two-story residence located some 250 feet north of the Cotton Palace was half destroyed in this manner.

It is of interest to note in this connection that another Texas city—Dallas—has just seen fit to rescind its ordinance prohibiting wooden shingle roofs. Notwithstanding the lead which the cities of the great Southern state are taking in the matter of enforcing the principle of individual liability for fires due to carelessness or neglect, there are evidently plenty of people still left in that territory who need to be awakened to an elementary sense of their obligations to the community in the matter of fire prevention.

One of the portable steam boilers used for thawing frozen hydrants in Montreal.

The Care of Fire Hydrants in Winter Weather in Montreal.

By T. W. Lesage,

Superintendent, Montreal Waterworks.

In the Montreal municipal waterworks system there are some 2,836 hydrants on the city streets. These are post hydrants of the Matthews type, compression hydrants with leather valve. These hydrants are generally made use of for all municipal purposes, street sprinkling and washing of pavements, flushing of sewers, etc., as well as for fire purposes.

The work of keeping the hydrants in proper order is done by a staff of inspectors whose numbers vary with the seasons of the year as follows:

In the winter months, 39 inspectors are employed for 18 weeks.

Spring and fall months, 19 inspectors are employed for 17 weeks.

Summer months, 11 inspectors are employed for 17 weeks.

It is the duty of these men to visit each hydrant as frequently as necessary, according to the seasons—from once or twice weekly in the summer time to once or twice daily in the winter time.

The city is divided into ten main divisions with a waterworks yard in each, to which the men report twice a day, by telephone if necessary, the result of their examinations of the hydrants.

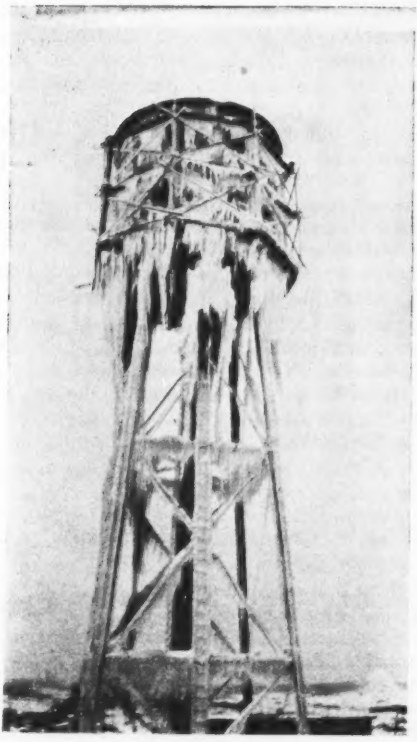
In the severe weather of mid-winter the hydrants are visited twice a day, and when found frozen are immediately reported.

For taking care of frozen hydrants portable steam boilers are used. There are available six of these steam boiler outfits, consisting of a vertical boiler of 12 or 15 h. p., mounted on runners in the winter time or on wheels in early spring, and hauled by a team of horses. Steam is maintained at a pressure of 20 to 30 pounds and the steam is used through a rubber hose inserted into the column of the hydrant through the hose nozzles. A few minutes warming up of the frozen hydrants with steam is generally sufficient to put them in working order.

In three of the waterworks yards or shops these boilers are kept with steam up all the time in severe winter weather. These yards are also provided with fire alarm gongs and in case of serious fires the steam boilers repair to the scene and render help in freeing the hydrants from accumulated ice or in thawing out the firemen's apparatus. After each fire also the hydrants used by the firemen are heated up and made ready for further service.

It is well to define here what is meant by the expression a frozen hydrant. There is, of course, the case where the water in the hydrant branch pipe is frozen, due to the ground being frozen to the depth of the branch pipe. This may be due to insufficient earth covering or to the nature of the soil or to certain conditions underground near the base of the hydrant, as the proximity of a street gully, etc. Otherwise hydrants are said to be frozen when it is impossible to operate or open them with an ordinary hydrant key or wrench. This may happen through the freezing of water entering the hydrant base through a leaky valve, or, as is more often the case in the severe weather of mid-winter, a frozen hydrant is one where the stuffing box and gland or binding nuts in the hydrant head are seized or frozen or bound together due to the contraction of the hydrant stem under severe cold. In such cases the application of direct heat with steam in the column of the hydrant is a most practical solution; and the same results could not be obtained so rapidly or efficiently by the application of electric heating.

Owing to the use of the hydrants for other municipal services of street cleaning and sewer flushing, about one-half the hydrants being used for these purposes in summer time, considerable attention has to be given the hydrants in the fall of the year to make the valves tight for winter use. At the first approach of cold weather it is also important to ease the binding nuts on the head of the hydrant to allow for the contraction through cold of the hydrant rod. The care and attention given the hydrants in this inspection at the approach of winter are most important and serve to minimize the troubles of winter.



Tank from which ice was shot with 44-calibre rifle.

Unique Method of Removing Ice from Sprinkler Tank.

By D. C. Winsor

In view of the discussion of the zero weather hazard at the annual meeting of the National Fire Protection Association in 1918, the method described for removing a large accumulation of ice from a gravity tank and trestle in the Canadian field may be of interest.

The tank in question is of 50,000 U. S. gallons capacity on a 90-foot independent steel trestle, and the normal pressure from the municipal waterworks, which is the other supply to the sprinkler equipment, is only slightly in excess of the pressure from the tank, but with a fire pressure of 100 lbs.

The original tank on the structure was replaced during the severe weather of 1918 when the temperature was 25 to 30 degrees below zero. The staging was, therefore, left in place to permit painting when the weather moderated, and the tank was filled and left in service. A few days later, when a fire pressure was placed on the city mains, a small piece of wood lodged under the check valve in the tank supply, with consequent overflow and a resulting heavy accumulation of ice, as illustrated.

A tank contractor was called in to relieve the situation. To attempt to remove the ice by chopping was dangerous for the part that could be reached, and impracticable for the larger portion. With the permission of the municipal authorities, it was, therefore, decided to attempt shooting the ice away in small pieces. This was successfully accomplished by the use of a 44-calibre Winchester rifle and 600 rounds of soft nosed bullets. The only damage was caused by a representative of the property owner, who desired to try his luck and dislodged too great a lump of ice, which in falling carried away some of the sway bracing and one tie rod of the trestle.

In the spring, the tank was painted, and apparently neither it nor the structure was affected by the heavy weight of ice, which was in position about a week.

Until the removal of the ice and the cleaning of the check valve, the tank supply was off the sprinkler equipment, which was under protection from the city supply.

It is estimated by the tank builders that the extra weight carried by the structure for the time mentioned probably amounted to about 15 per cent. or 62,500 lbs. extra dead weight. The extra area exposed to wind pressure probably increased the wind load 25 per cent., hence the factor of safety of tank trestle was about 3.4 for the posts. Some struts and wind braces had even a smaller factor of safety owing to the unevenness of the distribution of the extra ice load.

The writer is indebted to the tank builders for the accompanying illustration.

"Bricks Without Straw"*

By Ira H. Woolson,

Chairman, N. F. P. A. Committee on Building Construction.

The making of brick dates from very early times, and was practiced by all the civilizations of antiquity. We know that well-burned brick were extensively used by the Babylonians 3,800 years B. C. There were many other nations, however, who were brick-makers, but who did not learn, or at least practice, the art of *burning* them for 2,000 years or more after the Babylonians are known to have used burned brick.

The Egyptians manufactured brick upon a large scale, but they, in common with other peoples of that period, made their brick of river mud and dried them in the sun. They early learned that the mud alone lacked cohesion and made an unsafe wall, and it was found that chopped straw mixed with the mud or clay was a simple and efficient binding material which vastly improved the quality of the brick. Sun-dried brick were made in this way for many centuries—in fact, are still made to some extent upon the banks of the River Nile.

Those of you familiar with Biblical history will remember that unhappy experience of the Israelites when, as slave brickmakers in Egypt, they were compelled by Pharaoh to go out in the fields and highways and gather the necessary straw, and then make as many bricks in a day as they had previously made when straw was furnished them.

Straw was scarce, thus making the task exceedingly difficult, and the unfortunate fellow who failed to meet the requirements received a beating for his neglect. It was this cruelty which influenced Moses to take the part of his countrymen, and finally culminated in that famous journey toward the Promised Land.

I will not weary you by further recital of ancient history. The point I wish to emphasize is, that sun-dried bricks made without straw, or some equivalent binding material, lack the cohesiveness necessary to develop their full value. In other words, "bricks without straw" were unreliable as building material. With this thought in mind, I shall use it as a simile to indicate the impossibility of producng reliable fire-resistive buildings even with well-burned, high-grade brickwork unless it is reinforced with certain "straws" consisting of carefully planned structural features and suitable building equipment necessary to develop the full value of the fire-resisting qualities possessed in such large measure by brick.

Not long ago a certain brick promoter had for his slogan, "Build with brick and be safe from fire," and that idea is frequently promulgated in many forms. Taken at its face value, the idea, namely, that a building

*Paper read before National Brick Manufacturers' Association, February, 1919.

with brick walls is an entirely reliable, fire-resistive structure is misleading and fallacious. It is a case of "bricks without straw," and I wish to talk to you brick manufacturers today upon the necessity for using certain "construction straws" with your brick if you would have that old and reliable building material develop a reasonably high percentage of its fire-resisting quality.

As usually constructed, I doubt if the average brick building as a whole has a fire resistance of over 10 per cent. of that of its walls. This is discreditable to our engineering and architectural intelligence, and productive of shameful economic waste of manufactured resources.

I hope to win your aid in securing the introduction of such proper "construction straws" into brick buildings as will make them really efficiently fire-resistive.

Let me say, right here, that the defects which I shall criticise are by no means peculiar to brick buildings. They are just as prevalent in hollow tile, stone and concrete buildings. I am using brick buildings as my target merely because you are brickmakers, and members of this national organization devoted to your business interests. Furthermore, since brick is such an ancient and honorable building material, and probably used more generally than all other building materials combined, barring wood, it seems fitting that the brickmakers should take the lead in a united effort to remove this blot upon their escutcheon.

You manufacture a material tried by fire and adapted to withstand flame and high temperature for long periods. It is used to build chimneys, fireplaces and furnaces, and in such capacity has performed its function successfully for a thousand years, and yet the world is full of tottering, fire-ruined walls marking the site of once splendid buildings, now desolate monuments attesting the fire hazards of brick buildings improperly constructed. Isn't it a ridiculous anomaly, and one that our boasted twentieth century progressiveness ought to eliminate?

I never see such shattered, smoke-scarred remnants of noble buildings but I long for revenge, and feel that some one should be penalized for such needless waste.

Now, what are these "straws" which we must use with brickwork to make buildings safe from fire? The straw used by the Egyptians in their brick was, owing to scarcity, of various kinds, such as stalks of grain, grass, weeds and reeds, some large, some small. They were all useful, but some served their purpose better than others. It is the same with "construction straws"; they vary in size and importance.

The most essential is the elimination of communicating openings, large and small. I am inclined to think that the small openings are really the worst offenders because of their obscurity and general prevalence. Several of them are frequently overlooked, even in well-constructed buildings.

Buildings with large open wells or rotundas connecting several stories, which are common in public buildings, and frequently found in office buildings, hotels and department stores, are a type of architecture which should be thoroughly discredited, except possibly in public buildings, where it should be used only with special safeguards.

I wish to focus your attention specifically upon public buildings,

because they are peculiarly subject to intercommunication defects which cause rapid spread of fire. Such buildings are usually built of brick, even though frequently veneered with stone. They house large quantities of legal records, official documents, rare books and pictures, also historical papers and relics of great value. The burning of such a building is nearly always a public calamity, so there are at least *two* good reasons why you should be interested in preserving them.

As a rule, the architecture of such buildings is of imposing monumental character. They lend dignity to the municipality in which they are located, and are the pride of its citizens. They are well constructed with solid masonry walls, fire-resistive floors and roofs, high ceilings, massive windows, marble stairways, an elevator or two, large, heavy paneled doors, and all the features which, to the untrained eye, constitute a "strictly" or "absolutely fireproof building," and they bear that reputation. When they burn, as they frequently do, it is a puzzling surprise to the population. The fire is considered mysterious, and almost as much of a miracle as would be the burning of a stone pile. Usually the only mystery about the burning is that it had not occurred before.

The burning in recent years of the Houses of Parliament, in Ottawa, Canada, the State Capitol at Albany, N. Y., and the Federal Custom House at Bangor, Me., are typical examples of many which could be mentioned illustrating the weakness of this class of buildings.

Incomplete records show that 64 city and town halls were reported burned between March, 1914, and October, 1918. During the same period fires occurred in 37 court houses, 8 libraries, 8 jails and 15 miscellaneous public buildings. Some of these were absorbed in conflagrations, and would probably have been lost irrespective of the care taken to reduce the internal hazards, but many of the fires originated within the buildings themselves, and very often the destruction was complete. The list merely indicates the weakness of such buildings against fire. Every one of those ruins was a wayside advertisement testifying to the ignorance or carelessness of the architects and builders. Masonry walls did not protect them.

The greatest danger in such buildings is the open connections through all stories. Commonly, there are two stairways, more being added in proportion to the size of the building—the grand staircase near the main entrance, the service stairways at the rear or sides of the building, and often small private stairways coupling affiliated offices in different stories. These stairways are seldom inclosed, and therefore, with the hallways, constitute a network of open channels throughout the whole building, favoring rapid distribution of a fire.

The stairs leading from the basement or cellar are commonly cut off by doors at the first story level, but this advantage is usually depreciated by an elevator shaft which is open in the basement story, and having artistic metal grills as its only protection in the stories above.

Sometimes small hand-operated book or document hoists will be found, also dust or waste paper chutes, with an occasional ceiling ventilator from the top story rooms into the attic, which latter space is liable to be a repository for all sorts of inflammable material.

The number and variety of such communicating channels in some

buildings would almost lead one to believe that a fire fiend had planned them with diabolical cunning to insure the complete destruction of the buildings if ever they get on fire. Some of these minor flues are frequently installed long after a building is erected, and were the brilliant idea of an occupant who thought only of convenience, and had no conception of the danger he was creating.

Although the hallway floors of a building may be of tile or marble, and the stairways built entirely of brick, stone or metal, with no combustible material about them, they are nevertheless a serious fire hazard, because they act as flues to carry the hot products of combustion from a fire in one part of a building to another where combustible material is present. The danger of this method of fire transmission is little appreciated by those who have not studied it.

When air is heated to 1,000 degrees F. or over—which is a temperature quickly reached in most fires — it will ignite instantly everything combustible with which it comes in contact. The actual flames of a fire may extend only a few feet from the point of origin, but the hot smoke and invisible heat waves may easily travel through an incombustible stairway or hallway for 50 or 100 feet, and then ignite the whole surface of a wooden door in an instant. At the same time, glass door panels and fan lights will collapse by rapid expansion, and the intense heat entering rooms will cause them to burst into flames.

An excellent example of this occurred two years ago in the Hotel Lenox in Boston. The fire started in a bedroom on the third floor. The hot air passed through an open door and up through a stairway and elevator shaft of incombustible construction to the sixth story, and then traveled along the hallway until it found some doors left open by fleeing occupants. These rooms were burned out. At the same time it jumped from the sixth to the eleventh story and burned out a few rooms in the same manner. The intervening stories were very little injured, except in some cases there was surface burning of a small amount of wood trim in the hallways. This action of heated air is common, but a fire is not often extinguished in time to preserve the evidence so well.

For the reasons here explained, it is evident that hallways in all public buildings, as well as in office buildings and others, should be protected at reasonable intervals by fire-resistive partitions and fire doors, irrespective of whether there is any combustible material in the hallways or not.

It is also self-evident that all stairways and elevator shafts should be completely inclosed with fire-resistive materials, and that glass doors or windows opening into such inclosures from the interior should be prohibited.

Another class of fire-communicating channels in nearly all public buildings, and in many buildings of other classes which, though usually cut of sight, are nevertheless dangerous, are the ventilating ducts, also warm-air ducts, if that system of heating be employed. These metal ducts cross the basement ceiling to risers, which distribute throughout the building. The basement is usually the storeroom for boxes, old furniture, surplus publications and other highly combustible material. A fire occurring in the basement is likely to escape discovery until it has

gained considerable headway. If it becomes serious, the sheet-metal ventilating and warm-air ducts will get red-hot, and although no flame enters them, the air within is superheated and distributed through the building, igniting everything combustible it touches. Such pipes and ducts frequently have small wire supports which, when they get hot, lose strength and allow parts of the pipe to drop, thus providing the fire with open passage to all parts of the building.

It is surprising how small an opening through a wall or floor will suffice as a gateway for superheated air to start a fire on the opposite side.

Some of you may remember a report prepared by the speaker and published by the National Board of Fire Underwriters, about two years ago, describing a fire in a reinforced concrete building at Far Rockaway, L. I. I discovered that the fire entered the concrete building from an adjoining wooden building through a 4-inch hole in the concrete party wall, and then passed to two stories above by way of a 2-inch hole in each concrete floor, where a heater pipe had been removed. At another place the hot air went through a 1-inch hole in the party wall and set fire to a wood-pile.

We have abundant proof that many fires are transmitted through fire-resistive floors and walls by superheated air flowing through the small openings around pipes. This occurs even though the opening does not exceed ¼ inch.

The ordinary method of closing such openings by thin metal collars or plates is inadequate. All plumbing pipes should be tightly sealed with cement mortar where they pass through floors or walls, and the openings necessary around steam and hot water pipes should be packed with loose incombustible material.

The criticism offered on public buildings applies equally to all other classes of buildings. First-class office buildings are probably as safely constructed as any buildings having multiple occupancy, but they are seldom fully guarded against spread of fire.

The stairways and elevators are usually well protected, but frequently there are floor areas of several thousand square feet without a single partition which would restrict the spread of fire five minutes. They may have numerous brick, tile or gypsum partitions with glass panels in the upper portion. They have a decorative effect and assist light distribution, but are worthless as fire barriers. The glass breaks and falls with the first hot blast, and all the rooms burn as a unit.

This was a common method of construction in the great Equitable Building which burned a few years ago in New York. It was classed by its owners and the general public as a "thoroughly fireproof building." It burned with terrific fury in spite of the combined fire-fighting forces of New York and Brooklyn, than which no better exists. The reason was that the building was honeycombed with defects such as described.

Ordinary windows opening into air or light shafts constitute another defect producing rapid spread of fire. Flames enter the shaft and are forced upward by natural draft conditions, while at the same time heat accumulates in the shaft; consequently such windows frequently transmit

a fire from story to story. Only wired-glass windows in metal frames should be used in such locations.

However, the number of massive office buildings, apartments, hotels and similar high-grade buildings, subject to fire from defective construction, is small as compared with the great mass of brick walled buildings. The burning of one of these large structures is spectacular, and attracts attention because of its magnitude, but the destruction of a small brick building reflects just as severely upon the reputation of brick for fire-resistive construction as the loss of the large one.

Millions of brick are used each year in buildings of simple architecture and modest cost. They are undoubtedly less liable to complete destruction by fire than wooden buildings, but are by no means as fire-resistive as they should be, nor are they as safe as the public is taught to believe.

If chimneys in such buildings were properly built and isolated from all interior woodwork; if furred walls were completely fire-stopped at each floor and ceiling, and the roof fire-stopped at the line of the eaves; if stairways were enclosed wherever possible; if roofing were of incombustible material; if cellars were properly cut off from stories above by incombustible ceilings, and heating apparatus safely installed, such buildings would be immeasurably safer than they are now.

The Building Materials Division of the War Industries Board, of which the speaker is a member, is preparing to publish a complete record of its work in the conservation of building materials due to war emergency demands. It includes a section devoted to Fire Prevention and Fire Protection which, though primarily intended to safeguard war building projects, is nevertheless, in many respects, just as applicable to all medium-grade buildings. It comprises specifications and construction details, fully illustrated, covering all the principal weak points in non-fire-resistive construction.

Quite apart from my own association with the work, it was prepared by a group of well-qualified experts, and, in my opinion, is a very valuable contribution to the subject. It will have the endorsement of various governmental departments, and might be advantageously taken as the basis of such propaganda as I am proposing to you. Similar material can also be obtained from the National Board of Fire Underwriters.

The additional cost of such precautions would be small, and I am positive that if ordinary joisted brick buildings were erected with due heed to them, the security of such buildings against complete destruction by fire would soon become so apparent in fire loss records as to give ordinary brick construction the reputation for fire-resistance which it fully deserves, but does not now possess.

What have brickmakers done individually, or as organizations, to thus safeguard buildings manufactured from their product? Have they ever made any effort in this direction? I have gone over considerable literature distributed by them, and can find scarcely a reference to specifications of this character. You extol the virtues of brick collectively and specifically as to its permanence and beauty; you prescribe the character of joints, the quality of mortar that should be used, and

proclaim the fire-resistance of brick itself, but rarely, I might say never, a word suggesting methods of construction which would prevent a brick building being completely destroyed by a fire occurring inside or out. In other words, you have failed to insist that proper "construction straws" be used which would develop the full value of your material in the production of an efficient fire-resistive structure. In direct proportion to your failure to take such action, you have been "asleep at the switch," and blind to your own best interests.

You have been content to secure a customer for your product, and have given little thought as to how he uses it. But you may say, that is not our function; we cannot control design, or compel an owner or builder to incur the expense of special structural changes. It is granted you cannot command either of these things, but proper building construction is largely a matter of education, and if you, as brick manufacturers, were to continually insist upon the use of such standard construction features in buildings as would make them truly fire-resistive, you would not only advertise the possibility of really safe construction with your material, but at the same time would be inaugurating a propaganda for conservation of manufactured resources having the greatest national importance.

In my opinion, one of the most valuable things you could do for the future prosperity of your business and the economic well-being of your country would be to start a vigorous campaign for fire-safe brick buildings. Most people would build correctly if they fully understood the importance accruing to themselves by so doing.

You should take action of this kind to protect your own reputation as manufacturers of a building material which does not, of itself, burn. Every time a brick building is wholly destroyed by fire, it casts an undeserved slur upon your product, and the public begins to wonder whether, in the last analysis, a brick building is safer than a wooden one.

I regret to say that the architects are also largely responsible for the existing deplorable lack of fire-resistive building construction. A few of them are fully alive to the situation and are doing splendid reformation work, but the rank and file are sadly in need of education. You could undoubtedly exercise a beneficial influence in this direction.

The manufacturers of sprinkler heads insist that every sprinkler equipment shall be erected under their direction to avoid, as far as possible, any failure of the device to perform its function due to improper installation. Many other manufacturers are jealous of their products' reputation and, where not practical to personally supervise the use, they issue detailed specifications to control same.

Fifty years ago, when the National Board of Fire Underwriters was organized, some of its founders were of the opinion that it was not their province to tell the public how to build. Their motto was, in effect: "Let the public build as it likes and we will rate according to the risk." That theory was fundamentally wrong. It was discreditable to the business, and has been condemned these many years. Today the National Board of Fire Underwriters is devoting a large part of its great activity in an effort to educate the public how to build safely and

to properly protect individual buildings and cities after they have been erected.

It maintains a staff of engineers devoted to this work, and publishes much literature dealing with fire prevention and fire protection. It issues a Recommended Building Code detailing safe building requirements which it distributes gratis to those interested in the subject. It stands ready at all times, free of charge, to advise upon building ordinances or methods of construction which will aid in lessening our great national disgrace, known as the "annual fire loss." The task is a huge one, and can only be accomplished by co-operative efforts of all organizations interested in our civic and national welfare.

Other examples justifying the action that I am urging are unnecessary; there is abundant precedent for your organization to adopt a definite policy to use its influence collectively and individually in securing the use of such "construction straws" in brick buildings as will make the structures as a whole have a cohesive fire-resistance somewhat comparable with that of their walls. If I shall have been fortunate enough to have contributed something toward this end, I shall feel abundantly repaid for accepting this opportunity to come and talk to you.

Fire Hazard of Dry Cell Batteries.

By H. L. Miner,

(Member N. F. P. A.)

Fire Protection Engineer, E. I. du Pont de Nemours and Company.

During some recent experimental work involving the use of six ordinary commercial type dry-cell batteries connected together in series, the batteries were accidentally short-circuited and a distinct and unusual fire hazard uncovered. The batteries resembled others of this class, except that the carbon or carbon composition electrode, which is circular in shape, extends through and slightly above the surface of the compound with which the battery is sealed. The top of the electrode is consequently exposed.

The batteries were provided with special connectors. They were connected in series with No. 16 B. & S. gauge, rubber-covered fixture wire.

When so connected and short-circuited at special connector secured to electrode, *i e.*, contact made and broken between copper wire attached to one cell and copper connector of the other, the usual small spark or arc occurs. When a group of six are short-circuited and left in this condition for some time, the wire becomes slightly warm.

If, however, contact for short-circuiting is made between copper wire and top of carbon electrode, a brilliant hot arc is formed, similar to but smaller than the arc light. A portion of the heat so generated is instantly absorbed by the wire, and if the wire is left in contact with the carbon electrode, temperatures of approximately 2000° F., sufficient to melt or fuse the end of the copper wire, are developed. Under these conditions the insulation on the wire is easily and quickly ignited. This was repeated a number of times during laboratory tests. (See photograph which shows burning insulation. Ignition took place in less than

Burning insulation on wiring of dry batteries after batteries were short-circuited.

two minutes.) Paper or similar combustible material brought into contact with the arc or hot wire was readily ignited.

When the end of the wire was placed near edge of electrode, the intense heat vaporized the sealing compound at point of contact. The vapors given off proved highly inflammable and were, in nearly every instance, ignited by the hot wire or the arc. It was repeated a number of times to prove that it was not a "freak" condition. The flame from the burning vapors spread to the insulation on the wires, or the insulation ignited simultaneously, so that fire of considerable magnitude resulted. When the connection was broken, destroying the arc, the vaporization of the sealing compound soon stopped so that the vapor fire died away. This did not, however, affect the fire due to burning insulation.

Following this experience, seven different types of dry batteries were purchased for examination and test. Six of the seven types were practically the same as those first tested: namely, the top carbon electrode was exposed. In every case results identical to those cited above were obtained. One of the types received had the top of the carbon electrode covered with a brass cap which extended above the sealing compound and completely covered the electrode. Attached to this brass cap was

the binding post. The end of the carbon electrode is, therefore, fully protected, which prevented the development of the carbon arc when the batteries were short-circuited.

Five of the seven types had the metal container covered with a tight-fitting cylindrical cardboard carton. The remaining two were encased in loose-fitting, square, pasteboard cartons which completely covered the entire battery with the exception of the binding post and center electrode, which extended through holes in the top. This brought combustible material very close to the carbon electrode, and when this type of battery was short-circuited the flame from the burning vapors or insulation immediately spread to the pasteboard covering. No attempt was made to ignite the pasteboard by the heated wire or arc, but under certain conditions this is undoubtedly possible.

During tests, conditions which might develop in the field due to connections becoming loose or broken, or carelessness in replacing batteries or installing new ones, were duplicated. In one instance when endeavoring to bring about conditions which might develop due to carelessness on the part of the electrician, end of wire sank into sealing compound at side of electrode, became engaged and, remaining in this position, caused continuous vaporization of the compound, with resulting fire.

It has been and is common practice to install dry-cell batteries in contact with inflammable material in dusty locations, such as in grain elevators, wood-workers, cereal mills, sugar refineries, etc., and at places where undoubtedly inflammable vapors are present, due to the prevailing general opinion that a dry cell battery is practically non-hazardous. However, as brought out above, there are three distinct phases of fire hazard introduced by dry-cell batteries of this type, any one of which might result in fire.

(a) Arc developed between carbon and wire or hot wire or molten copper igniting dust, inflammable vapors or combustible material.

(b) Ignition of insulation.

(c) Ignition of vapor due to volatilization of sealing compound by arc or heated wire.

The following is suggested:

(a) Immediate inspection of all dry battery installations to make sure that all connections are in good condition and tightly secured.

(b) Immediately remove such installations from locations where inflammable dust or vapors are or may be present.

(c) Where facilities are available, top of carbon electrode might be covered with compound used for sealing batteries, leaving only copper connection or binding post exposed.

(d) Enclosures containing dry cells of this type should be of metal, or have interior protected with asbestos.

Static Electrical Hazard in Cotton Gins.

By E. K. Collett,

Assistant Secretary, Millers' Mutual Fire Insurance Company of Texas.

The large number of gin fires discovered during the operation of cotton gins in the past three years, which was a period of very dry weather, caused an investigation to be made as to why the fires were increasing regardless of the improvements in gin machinery.

A very careful study was made of each loss as it was reported—cause, time of fire, condition of cotton, etc.—and the inspectors were instructed to obtain information as to the small fires that were frequently happening, and to inquire where in the machinery these fires occurred. This investigation covered several hundred gins.

The combined experience showed that the overwhelming majority of fires during the operation of the gin occurred in the unloading system or in the cleaner. Matches were first thought to be the principal cause, and were convicted in the minds of practically all ginners as the cause of such fires as started before the cotton reached the saws.

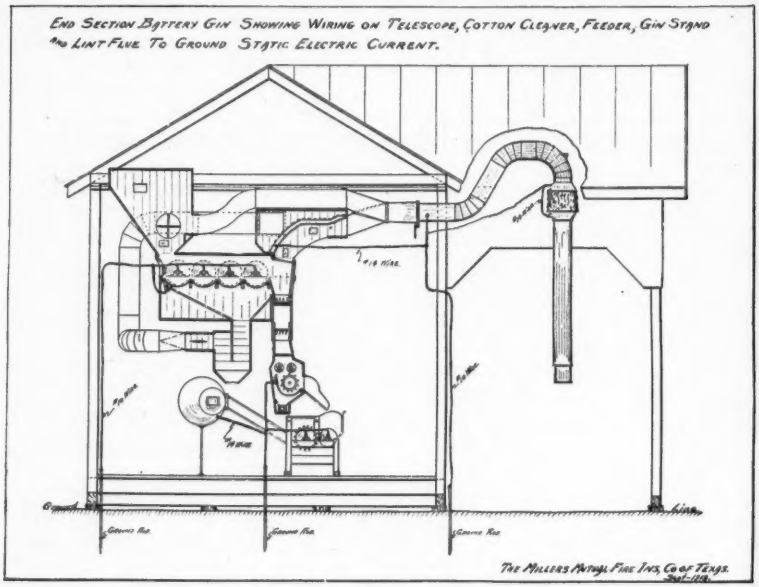
We learned of several gins having trouble in operating because of static electricity effecting the flow of cotton. These gins were likewise having frequent flash fires, which, however, were controlled before serious damage resulted.

This started our investigations, and as the United States Government was working on static electric hazards in flour mills and elevators, we decided to co-operate with it in studying static electrical effects in gins. A few specific cases will probably be of interest. In a North Texas town it was reported that the machinery of a new gin would not operate well. After it had been running about two hours it would begin to "clog up" and have to be cleaned. An investigation showed that it was heavily charged with electricity at the end of each short run. It was grounded to carry off the electricity and the trouble ceased. This was one of the first cases reported.

In a considerable number of the gins where fires were occurring static electricity was shown to be present, and after they were grounded the electricity disappeared and the fire ceased.

Recently in two West Texas towns, about fifteen miles apart, the gins were operating very poorly and four or five fires per day were reported. Government investigators were sent there and discovered that because of the dry conditions of the weather the gins were heavily charged with electricity when in operation. Both gins were grounded. They now operate well and all fires have ceased.

In India, a country where there is a dry and a wet season, practically all gins require grounding of machinery for satisfactory operation


End Section Battery Gin Showing Wiring on Telescope, Cotton Cleaner, Feeder, Gin Stand and Lint Flue To Ground Static Electric Current.
The Millers Mutual Fire Ins. Co of Texas.

Shows method of grounding metal parts of cotton gins.

during the dry season. This is owing to the peculiar atmospheric condition in that country, which greatly increases the static condition.

Here in Texas gins were discovered in West and Central Texas—where the three-year droughts have prevailed—that were having trouble in the operation of their gins because of the heavy charge of electricity, resulting in many flash fires.

The reports on the flash fires only, which enabled us definitely to locate the trouble, showed 350 fires occurring during the operation of gins; 220 of these were traced to fires in the unloading system, distributors or cleaners. Sixty-eight fires occurred in the breast of the picker roll. The balance occurred at various parts of gins or from unknown causes.

It will therefore be seen that a large part of the fires are started before the cotton reaches the saws.

A specification for the proper grounding of gins to prevent static electricity is indicated in the illustration accompanying this article.

Fig. 1. View showing position in which gate valve was found.

Gate Valve That Turned in the Ground.

By McKean Moffitt,

Superintendent of Water and Sewers, Wilmington, N. C.

Courtesy Engineering News-Record.

The accompanying view shows the nearly horizontal position in which a 12-inch gate valve was found on digging down to it on account of a leak. The valve is on a force main near the waterworks pumping station. The various connections are as shown in the sketch.

The valve was inadvertently left closed, and nothing was known of the fact until a blowout occurred. The writer's explanation is that with the gate down and the nipple and sleeve on the discharge side of the valve the pulsations from the pumps tended to push the valve off the end of the pipe and to close the space in the sleeve, left there when the cut was made. The continued strain finally caused a leak to start somewhere in the valve or sleeve joints, and it was several days before an attempt to repair the leak was made. Meanwhile the leak became so bad that attention could be put off no longer, and upon attempting to close the valve to shut off the water we could not reach the head nut. So we went back to the pumping station and shut off the water on the 16-inch line. We noticed that there was a great amount of movement in the piping and valve, so much so that with a sounding rod put down against the main one could distinctly feel the movement of the sleeve and valve with each stroke of the pump. The closing of the 16-inch valve just outside the pumping station stopped the major portion of the leakage and all of the vibration, as this left just the return line from the bypass connection shown on the sketch. The fact that the top of the valve rested against a large, heavy valve box, which in turn rested against a granite curbing,

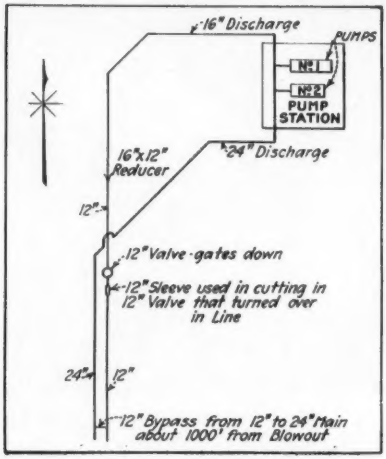


Fig. 2. Sketch of connections of piping, showing location of valve that turned over.

is all that kept the valve from turning further around than it did. The soil was light, fine sand, and when it became wet from the first small leak there was practically no lateral resistance to the movement of the valve until it carried the valve box over against the heavy curbstone. No attempt was made to right the valve. It was left in the position shown in the view, and a chamber was built around it so that a hand wheel could be put on the stem in place of a head nut.

In nearly twenty years' experience this is the first incident of the sort I have known. The pulsations of the pump are the only explanation of the turning of the valve that I can offer. The moral is: Never leave a valve closed on a main line if there is a chance that it will give way.

The Standpipe In Action.

By Edward R. Hardy,

Chairman, N. F. P. A. Committee on Field Practice.

There are few devices,—there may not be more than one, the sprinkler,—of which we have statistical records as to their efficiency in service and their economic cost. The solution of many problems of fire fighting and prevention would be measurably advanced if we did have more accurate data concerning the performance of various devices.

The subject of this article, the standpipe, does not lend itself to the accurate statistical treatment of the sprinkler, but some useful purpose may be served by the record for five years of the standpipe in action in New York City. It should be stated in the beginning that the records on which the article is based do not show what other devices, if any, were used at the fires in addition to the standpipe. The record is not, therefore, as valuable as would be the case if we had this information.

Charles F. T. Young, C. E., in his work, "Fires, Fire Engines, and Fire Brigades," published in London in 1866, stated (page 41) as follows:

> "In 1797, Sir Samuel Bentham proposed placing tanks on tops of buildings, connected with pipes laid all over the premises to be protected, and throughout the various floors, with provision at the various points for the attachment of hose and branch pipes; so that, in case of a fire breaking out, the pressure in the tank would furnish an immediate and powerful jet at whatever point it might be needed."

This is the earliest historical reference to the standpipe that I have found, and between that reference and the adoption of the standard of the N. F. P. A. there stretch more than one hundred years.

I became interested in the subject when the N. F. P. A. was developing its standard for standpipes, and I discovered that there were no statistics as to performance of the device. Five years ago I commenced to collect statistics, and part of the five-year record is presented herewith. The statistics are taken from the daily report published by the New York Fire Patrol, and show the use of the standpipe in New York City for the years 1914 to 1918, inclusive. If objection be made that the statistics are collected from an area of small dimensions, that can partly be met by the statement that probably there are more buildings in New York City of such a height as to call for a standpipe than in all the rest of the country. It would seem, therefore, that the use of the device in that territory should furnish as large a number of instances as could be collected from a goodly portion of the rest of the United States. There is also another value in taking the statistics from a limited area, and that is the fact that the New York Fire Patrol which publishes the reports from which the statistics are taken has been under one management, not merely for the five years in question, but for many years

prior thereto, and this makes their reports uniformly trustworthy. Another strong factor in favor of the reliability of these statistics is the fact that the fire department of New York City for many years has been in charge of Chief John Kenlon.

The statistics as presented cover the following information:

Table I. summarizes the use of the standpipe for each year; for each month; the number of times each month; the number of times used by the tenant alone; the number of times used by the fire department alone; the number of times used jointly, and finally, the number of times used for an exposure fire.

Table II. gives a list of the floors on which the standpipe was used, and shows the number of times the standpipe was used on each floor. It is interesting to note that from the sub-basement to the twenty-fifth floor, inclusive, the standpipe was used on each floor except on the eighteenth, twenty-second, twenty-third and twenty-fourth. It was used from the roof three times.

Table III. shows the number of lines that were used at the various fires and the number of times one or more lines were used.

TABLE I.

Showing Number of Times Standpipes Were Used in Fires in New York City.

1914.

Month.	Total No. of Times Used.	By Tenant Alone.	By Fire Dept. Alone.	Jointly.	Exposure.*
January	12	3	8	1	2
February	13	5	8	..	1
March	3	1	2	..	1
April	4	1	3	..	1
May	15	5	10	..	..
June	5	3	2	..	..
July	4	1	3	..	2
August	7	1	5	1	..
September	3	2	1	..	..
October	7	1	5	1	..
November	13	4	9	..	2
December	14	6	8	..	1
Total	100	33	64	3	10

1915.

Month.	Total No. of Times Used.	By Tenant Alone.	By Fire Dept. Alone.	Jointly.	Exposure.*
January	10	4	5	1	1
February	5	3	1	1	1
March	15	2	10	3	2
April	10	6	4	..	..
May	9	3	6	..	2
June	11	3	8	..	..
July	8	3	4	1	..
August	4	1	2	1	1
September	3	1	2	..	..
October	10	6	4	..	..
November	5	2	3	..	..
December	11	8	3	..	..
Total	101	42	52	7	7

1916.

Month.	Total No. of Times Used.	By Tenant Alone.	By Fire Dept. Alone.	Jointly.	Exposure.*
January	15	10	5	..	..
February	13	7	6	..	..
March	18	9	6	3	..
April	18	8	9	1	2
May	18	9	9	..	1
June	11	9	1	1	..
July	10	5	5	..	..
August	19	11	7	1	2
September	11	8	2	1	1
October	12	8	4	..	..
November	21	14	7	..	3
December	16	8	8	..	1
Total	182	106	69	7	10

1917.

Month.	Total No. of Times Used.	By Tenant Alone.	By Fire Dept. Alone.	Jointly.	Exposure.*
January	24	11	13	..	2
February	27	15	10	2	3
March	22	16	6	..	..
April	11	6	5	..	..
May	21	10	11	..	2
June	11	9	2	..	2
July	12	8	3	1	1
August	23	16	7	..	1
September	10	5	4	1	4
October	16	8	7	1	2
November	21	11	7	3	3
December	24	16	7	1	3
Total	222	131	82	9	23

1918.

Month.	Total No. of Times Used.	By Tenant Alone.	By Fire Dept. Alone.	Jointly.	Exposure.*
January	18	10	6	2	..
February	14	10	4	..	2
March	22	17	5	..	3
April	15	8	7	..	1
May	8	3	4	1	..
June	7	5	2	1	1
July	7	3	4	..	1
August	15	9	6	..	..
September	10	6	4	..	..
October	12	4	8	..	1
November	11	8	3	..	..
December	8	5	3	..	..
Total	147	88	56	3	9

* Fires listed under "exposure" though given separately under this heading are also included in the figures in the first four columns.

Summation of Table I.

Year.	Total No. of Times Used.	By Tenant Alone.	By Fire Dept. Alone.	Jointly.	Exposure.
1914	100	33	64	3	10
1915	101	42	52	7	7
1916	182	106	69	7	10
1917	223	131	83	9	23
1918	147	88	56	3	9
Total	753	400	324	29	59

TABLE II.

Showing Floors on Which Standpipes Were Used.*

Floor	No. of Times Used	Floor	No. of Times Used
Sub-Basement	13	13	8
Basement	60	14	3
1	81	15	5
2	55	16	2
3	64	17	3
4	62	18	..
5	65	19	1
6	72	20	1
7	53	21	1
8	48	22	..
9	37	23	..
10	26	24	..
11	25	25	1
12	21	Roof	3

*In 43 cases data as to floor on which used was not available.

TABLE III.

Showing Number of Lines Used at Various Fires.

Tenant.		Fire Dept.		Total.	
No. of Lines	Times Used	No. of Lines	Times Used	No. of Lines	Times Used
1	308	1	264	1	572
2	84	2	50	2	134
3	22	3	19	3	41
4	10	4	7	4	17
5	3	5	3	5	6
6	1	6	3	6	4
7	..	7	1	7	1
8	..	8	1	8	1
9	..	9	2	9	2
10	1	10	..	10	1

When I was preparing this article I wrote to John Kenlon, Chief of the Fire Department of New York City, and he has furnished me, with leave to print, the following interesting letter, which makes the best close to my article that can be made:

FIRE DEPARTMENT, City of New York.
January 22, 1919.

MR. E. R. HARDY,
Asst. Mgr., N. Y. Fire Insurance Exchange,
No. 123 William Street, New York City.

DEAR MR. HARDY:—

I have for acknowledgment your letter in which you say you have been interested for some years "in the use of standpipes for fighting fires," that you are putting statistical data into shape for an article in the N. F. P. A. QUARTERLY, and would like an expression of views from me on the use of standpipes in general, and whether or not we use the hose which is permanently attached to the standpipe in the building, or if it is always necessary to take that hose off and put our own hose on.

It must be clear to any man having even an elementary knowledge of fire-fighting in buildings over one hundred feet in height that standpipes are necessary. The loss of time in stretching a line of hose up a stairway to a height of one hundred feet, getting sufficient hose to cover the floor, and the physical effort required to do such work raises an insurmountable barrier against successfully coping with a fire at this, or a greater, height, except with standpipes. Furthermore, the extreme friction loss and consequent strain on the hose would be too great. Bursting hose would invariably be the rule under such conditions, with the consequent flooding of the building.

Standpipes are an absolute necessity in a building over one hundred feet. As you are aware, our Building Code requires standpipes in all new buildings over eighty-five feet in height.

Great care should be exercised in the installation of standpipes. In many places the checks are misplaced and the outlet valves on siamese connections are of a sub-standard type which may render the whole equipment useless if subjected to any extraordinary strain.

As a rule, we discard the hose on the valve outlets for the reason that it is generally of very poor quality. The inside lining is so rough that it is difficult to get an effective stream through it, and so porous that the water passes through it like passing through a sieve. But there are times, and many times, too, when we use the hose in the building to good effect.

Let us assume a fire in a 6-story building, flanked on both sides by 12-story buildings. Let us further assume that the 6-story building is completely involved, with the fire going through the roof. Such a condition gives an immediate and dangerous exposure to the buildings on both sides.

Hook and ladder companies, under such conditions, would be immediately assigned to positions in the 12-story buildings, lines would be run into the standpipe on each side and the hook and ladder companies, divided up, would instantly cover those buildings by using the hose attached to the standpipes on the several floors. They would, of course, be reinforced by engine companies, but the first engine companies arriving would connect to the sprinkler equipments, water towers and turret pipes, and particularly would they have to cover the rear exposures.

Much has been said of late about the necessity of having hose on standpipe outlets. Many theorists are of the opinion that the hose is of no use and should be discarded. There may be, no doubt are, some isolated cases where there are no possible outside exposures, where the occupancy of the building is of such a character that fire could not possibly gain any great headway. In such cases hose might perhaps be dispensed with, but, after all, fire is so tricky, so many things happen that cannot be foreseen, that I believe it is a wise precaution to have the hose already attached to the standpipe to be used by the employees or by members of the Fire Department as the occasion may arise.

Very truly yours,
JOHN KENLON,
Chief of Department.

Army Type Gas Mask in Fire Protection.

By J. I. Banash,

Chairman, N. F. P. A. Committee on Gases.

When the armistice was signed the United States had in very large production the Tissot type of gas mask, which was and is undoubtedly the highest development of the gas mask for warfare purposes. When production was suspended, it was decided to sell as souvenirs the masks which had been worn in training, and also to sell masks designed for actual industrial protection, with the suggestion that any one proposing to use the mask for protection purposes should so specify in order to be certain that new masks and canisters would be forwarded.

Some firms, grasping the possible importance of this step and understanding the high development of the gas mask in question, purchased these in quantities, and have even made preparations to continue their manufacture. Therefore the following notations, taken from the best available information at the present time, will undoubtedly be of interest to members of the National Fire Protection Association.

The army gas mask as such was, according to the Army, designed to afford, with one canister, protection against a very large number of different gases and fumes, and for this reason it cannot be expected to give as perfect protection against any single gas as could be provided by a canister especially prepared for that particular gas. The same would hold true to a somewhat less degree if only a small number of gases were to be anticipated.

As far as the construction and serviceability of the mask itself, aside from the canister, is concerned, the latest developed mask is a considerable step in advance of its predecessors. It is simple, easily adjusted, and many of the features which previously made the wearer uncomfortable have been eliminated. There is no nose clip and no mouthpiece, and the user breathes naturally in the regular manner. Air is admitted through a circular rubber valve in the bottom of the canister, which acts as a check, and on exhaling the vapors pass out through an ingenious rubber valve below the chin. Both these valves, which have very little movement and are the only moving parts in connection with the apparatus, are well protected against injury and, so far as the present indications show, the main object of investigations in the mechanics of this part of the equipment is to find a quicker method of adjusting a new canister when the previous one is exhausted.

A number of manufacturers are experimenting with various methods of holding the canister and with improvements in the canisters to afford protection against various specific gases (and combinations of them) and to afford protection of longer duration than is given by the Army mask, the standard canister accompanying which contains charcoal and

soda-lime mixed and is divided internally with cotton pads. The Army canister is not full, as it is desirable to limit the weight for Army purposes.

When it is considered that the Army canister is designed only to protect against the concentrations of poisonous gases which might be found in the open air, it can readily be seen that its life in higher concentrations would be short, and therefore for the latter use canisters should be especially designed against the gases anticipated.

Neither the Army canister nor any canister now on the market gives any practical protection against carbon monoxide, which may be found when there is leak in city gas, or near smoldering fires to which the air has not had free access. It is expected that there will be available in the near future canisters giving protection against this gas, which is an insidious poison and does not give warning of its effect. Absorbents for this gas, which can be used in combination with absorbents for other gases, have been developed under the direction of the Bureau of Mines and under the Chemical Warfare Service, and it is expected that in the not distant future these may be made commercially available.

For the present it must be clearly kept in mind that no gas mask of this character should be used in an atmosphere which contains less than 12 per cent. to 13 per cent. of oxygen, that is, in an atmosphere where an ordinary lantern will not burn, since this mask forms no protection against a deficiency in the oxygen supply, and if there is not a breathable amount of oxygen the mask is of no value. Even when wearing the mask men should not enter alone places where carbon monoxide may be present. This gas affects the blood—not the lungs—and its poisonous effect is not felt until the person subject to its influence is overcome.

Carbon dioxide, on the other hand, the product of complete combustion, affects the lungs when it is present in dangerous quantities, since it tends to choke a person owing to its stifling or blanketing effect in deadening the air.

The next important question to be considered in fire protection work is the amount of protection against smoke. Although the standard Army canister gives a fairly good protection against ordinary smoke, it is not guaranteed to give a perfect protection against heavy smoke such as is sometimes produced within a burning building, although if no better protection were available there is no doubt that the Army canister would be of great benefit in going into an atmosphere filled with smoke. It certainly is of benefit in the smoke found in outdoor fires, such as forest fires.

Protection against ammonia fumes may be very valuable industrially as well as in fire protection, but it may be noted that the standard canister does not offer complete protection against ammonia. There are efficient ammonia removers on the market in canisters put out by various manufacturers, as will be noted below.

So much for the standard gas mask as put out by the Government. Now it will be well to consider improvements which have recently been made for industrial purposes. In this connection it may be noted that not only have canisters been considerably improved to give longer periods of protection in such concentrations of gases as usually occur, but also

special attention has been given to furnishing combination canisters to protect against the usual products of combustion, including smoke. Canisters are now available which will completely filter all smoke out of the atmosphere without excessively restricting breathing. It is also to be noted that if the concentration of the gases in the air is increased, the life of the canister is simply reduced, and in some cases may be very short. When first entering a dangerous atmosphere wearers of masks should watch themselves carefully to note any tickling in the throat or smarting of the eyes. As the failure of a canister is gradual and not sudden, these symptoms will be an indication that a new mask is needed.

There are also canisters of special design surrounded by an envelope of special pulp or specially prepared paper so that the densest smoke will be safely filtered out. This is a mechanical separation, and naturally the larger the area of the filtering material the less resistance there will be to breathing. When it is considered that a man who is exerting physical effort breathes approximately thirty-two litres of air per minute, it will be apparent that this is an item of very considerable importance.

Complete absorption of ammonia may be obtained by commercial canisters now available, either separately from the combination smoke and gas canister or combined, so that only one canister need be carried. When the ammonia canister is separate there is a three-way valve so that if a person enters a room where there is escaping ammonia he need only use that particular canister.

The National Board of Fire Underwriters has recently published a statement showing the effectiveness of masks in confined spaces where fires were deliberately made to give off very noxious fumes. Fires of yellow pine were allowed to burn until the smoke was so dense that an unprotected man could not withstand it. Scrap rubber was added to such a fire and also sulphur, and whereas men not protected could not stand the atmosphere, there was no difficulty for those who were properly equipped with masks.

An important feature to be noted is that the rubber parts tend to become brittle and deteriorate if stored in light and warm places, and each mask should preferably be in a tight box or case. After use of the mask and also before using, the face piece and rubber tubing should be examined for leaks by putting on the mask, tightly closing the inhalation valve on the canister, and inhaling. The user should be able to hold the vacuum for about half a minute if there are no leaks. In any case, there should be such a test made periodically in case the mask has not been used.

It is extremely difficult to estimate the ultimate life of the Army type of mask, but conservative opinion would look for at least two years. Thorough inspection and test at the end of that time can determine whether masks should still be kept in service. Relative to the life of a canister, not so much can be said definitely. The best conservative authorities at the present time would agree that the life of the canister depends upon its use. Without any use whatever canisters should certainly be in good condition for several years if the plugs are not removed. On the other hand, a single fire might put the canister out of commission,

especially if water got inside. Ordinarily, if kept dry, a reasonably long service from the canister may be expected, but this depends very much upon the concentrations of the gases or vapors or smoke in which the canister is used, and the products of various manufacturers may differ according to the size of the canister and the amount of material contained. It is perhaps conservative to expect about 100 hours in low concentration or in smoke alone, and, as previously noted, one valuable feature is that the masks do not fail all at once, but give reasonable warning.

There is unfortunately at present no way of determining exactly how much life is left in a canister without running a life test which puts the canister itself out of commission for all further use. On the other hand, the chemicals do become rather clogged as they deteriorate, and a resistance to flow test might be of value. A new canister should have a pressure drop not exceeding 3½ inches of water column at a rate of flow of about 3 cubic feet or 85 litres of air per minute through it. If the pressure drop increases much over 4 inches it is an indication that the canister is probably unfit for further use. In this connection it is well to note that a canister is used up three times faster when a man is working vigorously than when he is at rest.

Conclusions.

In general, conservative consideration of the subject leads to the conclusion that the Army type of gas mask with proper canister may very frequently be of service where oxygen breathing, on account of its cost, weight and hindrance to a man in action, and also on account of the instructions necessary in its use, would not. It is believed that the Army type of gas mask will be found to have a very favorable field experience when properly handled, especially since a fireman's occupation is a hazardous one anyway, and he would necessarily have to enter many dangerous places in the ordinary course of his work, and whatever added protection can be furnished is of value. A false sense of security is to be strictly guarded against, and careful consultation with the manufacturers of the masks and canisters before purchase is strongly recommended so that the canisters will be of a type suitable for the hazards which may reasonably be expected.

The gas mask is no panacea to eliminate all risks from fire fighting, but it has a large field of usefulness, and development work by commercial firms and the U. S. Bureau of Mines will, from present indications, tend to extend the utility of the apparatus.

Recommendations.

For the benefit of those who are interested or who may become interested, the following recommendations in connection with gas masks are offered as a consensus of the best opinions at the present time:

1. Keep the canister closed until it is opened for use, and avoid getting water into it. If it becomes thoroughly wet it must be rejected.
2. Do not enter a room where a lantern will not burn. This will represent a concentration of about 16 per cent. of oxygen.

3. When a tickling sensation is felt in the throat or irritation in the eyes, get into a safe place and change canisters.

4. Keep extra closed canisters on hand where they will be available and never open them except when they are to be used.

5. When insufficient oxygen is suspected in closed places, they should be ventilated before entering. A smoldering fire may be the cause of carbon monoxide, or may have used up the oxygen in the air so that there will be insufficient left for breathing purposes.

6. Do not depend upon the gas mask for protection where carbon monoxide, illuminating gas, producer gas, blast furnace gas, or any other gas which contains carbon monoxide is present until equipped with canisters which are known to be reliable against such gases. Such canisters, as noted above, may be produced in the near future.

7. Be sure to read the label on the canister, and do not use in dangerous atmospheres which are not indicated thereon.

8. Make periodic inspections of the tightness of the gas mask, as previously noted, and examine the valve and all joints to see that they are tight.

9. Keep the masks and canisters cool and dry, and keep the masks in a closed box to shut out light.

10. Reliable manufacturers marketing masks and canisters should be consulted before purchase as to the use for which their canisters are intended, and the wearers of gas masks should be entirely familiar with their use and care before going into a dangerous atmosphere.

11. In case of any doubt on technical points, reliable information can be obtained from the Experiment Station of the Bureau of Mines, Pittsburgh, Pa., and from the Defense Research Division of the Chemical Warfare Service, United States Army.

Failure of Pressure Tank for Sprinkler Equipment.

Special Report by St. Louis Fire Prevention Bureau, Geo. A. Madison, Chief Inspector.

(Member N. F. P. A.)

On July 12th, 1919, about 10:00 a. m., the head of one end of the pressure tank for a sprinkler equipment in the city of St. Louis blew out with a loud report and great force, apparently loosening at the bottom first, blowing the head partly through the roof, breaking some sprinkler pipes, then falling on the floor, breaking holes through the floor as it fell.

The tank had been pumped up by the engineer about an hour previously, and a few minutes before the head of the tank let go one of the employees on the floor observed that it was leaking around the end rivets; he notified the factory manager, but before the manager and the engineer could reach the tank or release the pressure the head blew out. This tank was located on the sixth floor, halfway through the brick division wall of two six-story brick, joist constructed buildings, its principal support being the division wall, the ends resting on wood

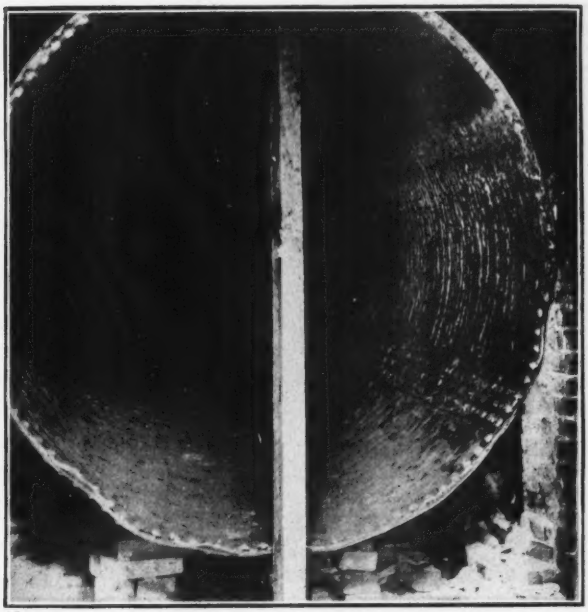


Fig. 1. End of pressure tank after head was blown off.

cradles. The force of the recoil, when the head blew out, broke the discharge pipe under the tank and threw the tank itself back about eight feet, slightly injuring an employee. There were no other persons injured, but the factory manager and the engineer had a narrow escape, as they had reached the top floor on their way to the end of the tank which blew out, where the pressure gauge and air valve were located.

This tank was installed in 1889, or about thirty years ago, having been in continuous service ever since. It was approximately five feet in diameter and twenty feet long, having a capacity of about 3,000 gallons, and being kept two-thirds full of water, with 75 to 80 pounds air pressure. The shell was in three sections; the longitudinal seams were triple riveted; the girth seams and heads were single riveted, the rivets being 5/8-inch and spaced 1½ inches on centers. The thickness of the shell plates was ¼-inch and thickness of the heads 3/8-inch. Metal of the tank in general was found to be in fairly good condition, considering the length of time the tank has been in service; however, some places in the lower part of the shell and the heads, which had been constantly under water, had been reduced by rust and corrosion in the thinnest places from the original ¼-inch to approximately 1/8-inch in the shell and from 3/8-inch to $\frac{3}{16}$-inch in the heads. The tank has been cleaned several times and slight leaks have been calked, but no serious defects have shown in the tank otherwise.

Fig. 2. Head of pressure tank after rupture.

As will be observed from the photographs herewith reproduced, the metal in the head was sheared irregularly through the rivet holes, but mostly outside the rivets. None of the rivets were sheared, and only a few were pulled through the rivet holes.

Upon the assumption that an excessive pressure had been pumped on this tank, investigation was made, but no evidence has been obtained to verify this assumption; the engineer maintains that the pressure which he had pumped on the tank that morning did not exceed 80 pounds, and the investigators are not in position to contradict this statement. The pump used is a steam pump, 10 by 18 inches, supplied from high-pressure boiler maintaining about 115 pounds of steam; there is no relief valve in the air line from the pump to the pressure tank. The pressure gauge at the pump, by which the engineer was guided when pumping, was tested the following day and found to be correct. This unusual occurrence, however, emphasizes the necessity of insisting upon installation of reliable relief valves in air lines, not only in new equipments, but also in old equipments where relief valves may have been omitted.

The physical damage consists of the damage to the tank, a few broken sprinkler pipes, slight damage to roof and floor, and water damage to stock on all floors of these buildings, which are occupied partly for the manufacture of chairs and partly for the manufacture of paper cartons.

Fire Dangers of Explosives and Acids.*

By W. S. Topping.

High explosives, such as dynamite, are sensitive to shock and friction. Dynamite, because of faulty manufacture, or possibly because of defective storage conditions, may leak in transit. The nitroglycerin, which is the explosive component, exudes from the cartridges and soaks or leaks through the wooden boxes, forming pools on car floors or station platforms. When such conditions arise, the greatest care must be exercised in the treatment of this material. The nitroglycerin is extremely sensitive, so sensitive, in fact, that it cannot be safely transported by rail except when thoroughly incorporated in the dope used in the manufacture of dynamite. When this liquid is rubbed between metal surfaces or struck by a hammer, an explosion is easily produced, and such an explosion in connection with an adjacent shipment of leaking dynamite will invariably result in complete detonation of the entire mass.

Black Powder.

Black powder is usually shipped in metal kegs, and under the regulations these kegs are so loaded and stayed as to prevent movement in ordinary transportation, but the shocks cars receive incident to switching and yard movement sometimes have the effect of breaking down the staying and of permitting the kegs to roll over the car floor, and our records show many instances wherein these kegs have been ruptured and grains of powder spilled on the floor. In not all of these instances, however, has an explosion occurred, because of the care exercised by railway employees upon discovery of these bad conditions. It goes without saying that the proper place for explosives is in their containers, and not strewn over a car or warehouse floor.

Black powder is much easier of ignition than is dynamite or smokeless powder, and when the leaking grains of powder are ignited, even though the ignition of these grains may occur some distance away from the kegs of powder, there is a grave possibility of the ignition communicating to the entire shipment. In a case which happened some years ago, some kegs of black rifle powder were found in a damaged condition with powder strewn over the car floor. All the loose powder was scraped up and the car thoroughly swept, the sweepings being thrown out on the ground through the car door. A railway employee or bystander, acting in a very foolhardy manner, threw a lighted match on the ground among the sweepings. There was an immediate flash, which communicated to the kegs of black powder still in the car, with the result that three persons were killed and seven persons seriously burned.

The ignition of black powder may easily occur through a spark made

*From an address before the Railway Fire Protection Association.

by contact between metal surfaces, or a flame from a lighted torch. A lighted hand-lantern, while not the safest sort of a light to use around black powder, probably would not cause trouble.

Handling Acids.

In the year 1916 there were 536 accidents connected with the handling of acids, which resulted in the injury of 35 persons and a property loss of about $75,000. It will, of course, be understood that of all the various kinds of acids handled, the most dangerous in transportation are nitric acid or mixed nitric acid and sulphuric acids. Either of these acids will cause fires when in contact with combustible material. The use of glass containers for the shipment of nitric acid undoubtedly is the cause of practically all of the fires, taking into consideration the failure of shippers to properly prepare their packages, rough handling on the part of carriers and failure of carriers' employees to exercise proper supervision over the acceptance and loading of such shipments.

Analyzing the causes, we find that shippers are generally extremely anxious to get their shipments off, and they may use for nitric acid carboys that are cushioned in hay, straw or some other combustible packing which is permitted for the shipment of sulphuric acid, but prohibited for the shipment of nitric acid. On the other hand, they may use a carboy with approved method of packing, such as mineral wool or kieselguhr, or they may use the stahl-packed carboy, which packing consists of grooved wooden cleats. Shippers are known to be careless about putting stoppers in their carboys. They use earthenware stoppers with clay or plaster of paris, over which they tie a piece of burlap and around the neck of the carboy. At the time such shipments are forwarded to the freight houses the receiving clerk may be very busily engaged, and he may fail to look at the package to see whether or not it is properly stoppered. The bill of lading is signed and an insecure package placed in the channels of transportation. On the wagon trip to the freight house the bouncing the carboys received has caused the plaster of paris to loosen up, and some of the acid splashes out because the stoppers do not fit tightly. The nitric acid attacks the burlap and eats it away. The carboys may not have been examined by a railroad employee, and they have loaded the car. The movement of the car continues the splashing of the acid, and in course of time the nitric acid acts on some combustible material, causes ignition and subsequent fire.

Gasoline Tanks.

It should be remembered that the so-called "empty" tank car that has contained gasoline, or even any of the higher flash-point liquids, is always a source of fire hazard. The regulations require that the dome covers must be in place, and there is a good and sufficient reason. Any tank car that has contained gasoline or even the heavy oils that are not inflammable under the regulations contains a large amount of inflammable vapor, and the records show many instances where railway employees have been seriously burned and where fires have been started due to the ignition of these vapors by dropping a lighted lantern into an open dome. It is not a safe practice to use a light around dome covers,

whether the tank be full or empty; and again, there is shown the necessity of employees equipped with hand-lanterns appreciating the dangers incident to their use. The introduction of hot rivets into a tank for the purpose of repairing tank cars, while not as prevalent as formerly, perhaps due to the effective educational efforts of the Bureau, still results in the occasional death of a railway employee.

Extinguishment.

When fires occur in connection with the transportation or storage of explosives or other dangerous articles, the one important thing to do is to stop the fire in its early stage, and for this purpose qualified and well-trained employees are essential. The best manner of extinguishing these fires depends upon the immediate existing local conditions. Fires caused by nitric acid or mixed nitric and sulphuric acids can be controlled by the use of water. In the application of water care must be exercised, as in contact with acid it is liable to cause slight explosions, accompanied by the projection of hot acid, which may cause dangerous burns. Therefore the water should be applied from a safe distance. Sand may also be used to stop a fire started by acid, but if the fire has thus been stopped, the early use of water is desirable to prevent the fire breaking out again. Thoroughly flush away any remaining acid and remove leaking or dangerous containers. In all fires caused by nitric acids a considerable amount of nitrous fumes will be given off; these fumes are extremely irritating and are poisonous. Employees should not enter a car or other confined space where such fumes are present.

When Match Cartons Burn.

Fire in a case of friction (strike anywhere) matches frequently involves ignition of the match heads in one or more of the inside cartons. If the outside box is not broken open and the smoke dies away after a moment or two, no further action is necessary, as the fire has already been extinguished for want of oxygen, and nothing will be gained by opening the box. If the fire has gained some headway, the burning box or boxes should be removed from the car or warehouse, if this is possible, or water should be freely used. Boxes should not be broken open, as the fire will be increased by such action.

Water for Charcoal Fire.

Fires in ground charcoal or in charcoal screenings are best handled in removing the burning packages (usually bags). If conditions are such that removal is not possible, water may be used sparingly to extinguish the visible fire; then remove all the charcoal and separate the wet from the dry charcoal. The dry charcoal should be stored under cover and under observation for several days before permitting such a shipment to be moved forward, as it is probable that fire may break out again. The wet charcoal should be destroyed, as it is unsafe to transport. Fires in lump charcoal should be extinguished with as little water as possible and the wet charcoal removed from the balance of the lading. The same precautions as to observation for several days should be followed to see that fire does not again occur.

Blanketing Gasoline Fire.

Fires which involve only a small amount of gasoline can often be extinguished by the liberal use of water; but if there is a large amount of gasoline already ignited, water will only spread the fire. Sand or earth should be used to control the flames of the burning gasoline, and could possibly be used in sufficient quantity to smother the fire.

Fire involving tank cars may occur through ignition of the vapors escaping from a safety valve. The burning of these vapors and even of the liquid itself is not a serious matter, except where a source of trouble to surrounding property. An effort should be made to promptly extinguish such fires by the use of wet bagging thrown over the safety valve, pouring on sand in quantity on top, or, if the means are available, by the use of a heavy jet of steam. If this cannot be done, isolation is the proper course to pursue, and the fire will eventually burn itself out.

Sawdust may be used by means of long-handled shovels in extinguishing fires involving open tanks. The sawdust is not easily ignited, but floats on the surface, forming a blanket, which will exclude the oxygen of the air.

Fumes of Sulphur Suffocating.

Fires in sulphur are best extinguished with water, or if discovered at the start the burning portion may be removed. Sulphur does not burn rapidly nor will the fire spread rapidly. After a fire is apparently extinguished, the shipment should be kept under observation, as, owing to the low ignition temperature, fire may burst out again. The fumes are suffocating and should be avoided by employees.

Nitrate of soda is not easily ignitable, but when intimately mixed with organic matter, such as jute bagging, is liable to cause serious trouble if ignited. The melted nitrate contains a great deal of heat, and when water is thrown on it the sudden generation of steam will cause the melted nitrate to scatter and start a fresh fire. Whenever practicable, fires in shipments of nitrate of soda should be smothered immediately, as they are difficult to extinguish with water after gaining any headway.

Ammonia for Bromine Fumes.

Leaking or damaged cases containing bromine require careful attention in order to avoid fire, and particularly personal injuries. Bromine is a heavy reddish brown liquid, which at ordinary temperatures gives off poisonous, suffocating vapors of the same color. Its odor is very irritating to the eyes and throat. The fumes are, therefore, objectionable, and a small leakage of bromine will cause a large amount of fumes.

Fumes of bromine may be neutralized and settled by using ammonia water or household ammonia sprayed through a sprinkler or watering pot. Sufficient ammonia should be sprinkled to counteract the bromine fumes, and the box and packing saturated with the bromine should be saturated with sufficient ammonia so that the odor of ammonia becomes more noticeable than the bromine. After neutralizing the bromine, the broken or leaking bottles can be removed from the cases.

Department of Fire Record.

Candy Factories—Fire Record.

In the candy making industry there are many large plants devoted exclusively to this one line of business; but there are also numerous small factories located in tenant manufacturing buildings, many of which are of inferior construction. In the latter, of course, standards of housekeeping are not so high as in the former, and many of the fires reported would seem to result from the unsuitability of the quarters occupied in tenant buildings rather than from the inherent hazards of the industry.

This is illustrated by the high proportion of boiler and rubbish fires. Boiler fires call for a word of special explanation. In many cases boilers are installed on floors above the basement and often it is not clear whether they are special equipment for the candy factories or ordinary heating installations. Presumably many of them are special equipment. In any case, a number of fires were due to faulty judgment in location and poor protection. Boilers were placed in rooms with wooden floors or too close to wooden partitions, and carelessness was shown in the handling of waste paper and rubbish which were burned under these boilers.

Spontaneous combustion is freely quoted as a cause of fire in sweepings in candy factories. There is no definite evidence, however, that this class of sweepings is particularly subject to this hazard. To attribute spontaneous combustion to the fermentation of sugar in the sweepings would require us to assume that this refuse had been left uncared for for a considerable time under conditions of moisture. This seems improbable in so many cases. It is understood that cocoa oils are not specially hazardous and it is therefore not unreasonable to place a great part of the responsibility for these fires on poor housekeeping in many of the smaller plants. It is essential, in any case, that sweepings should always be placed in metal containers and stored outside when it is impossible to burn them at once.

In connection with cocoa grinding and sugar pulverizing, attention is drawn to the dust explosion hazard. No great hazard to life seems to be involved, but in a few cases considerable property damage has been caused by these explosions and many fires have resulted from them. The blower systems handling these hazardous dusts should be safeguarded by some sort of pressure relieving device with discharge outside the building. The installation of such devices would prevent mechanical injury to the blower piping and do away

with the fire hazard which is introduced when the flare of an explosion enters a room.

The percentage of miscellaneous special hazard fires is high, and this is interesting because this classification includes several well-recognized hazards, such as an open flame over a tank containing a high percentage of alcohol, heating paraffine over a gas furnace, the boiling over of a pan of grease, a blazing grain of pop corn being dropped into a storage bin, etc. These hazards were held responsible, however, for only a single fire apiece.

In the sprinkler tables, under the heading "Efficiency of Water Pressures on Sprinkler Systems," it will be noted that, for pressures of 25 to 49 pounds inclusive, an average of 8.10 sprinklers opened to extinguish fire as against an average of 4.20 to hold fire in check. The former figure is high and is accounted for by one fire in which, due to the peculiar construction of the building, 48 heads opened on a dry pipe system to extinguish a small blaze. The average number of sprinklers operating in the other nine fires in the classification referred to was 3.64. Further particulars of the unusual fire (S-17748) will be found under "Points of Interest" (p. 179).

The special hazards are not severe, as is shown by the fact that only 11 per cent. of the fires in this class caused large losses.

In sprinklered factories of all types the proportion of large losses was only 8.2 per cent, notwithstanding the fact that the finished product and all materials used for packing the product are peculiarly susceptible to water damage. The record for really well equipped separate plants with good housekeeping is even more satisfactory.

CANDY FACTORIES—FIRE RECORD.

Total Number of Fires Reported, 215.

1. Classification of Causes.

Common Causes.

	No. of Fires.	Per Cent. of Common Causes.	Per Cent. of Known Causes.
Rubbish (or sweepings)	11	15.1	7.3
Power	6	8.2	4.0
Boiler (or fuel)	14	19.2	9.3
Chimneys (or flues)	2	2.7	1.3
Lighting	10	13.7	6.7
Oily Material	6	8.2	4.0
Heating	7	9.6	4.7
Smoking (or matches)	15	20.6	10.0
Miscellaneous	2	2.7	1.3
Total	73	100.0	

Special Hazard Causes.

	No. of Fires.	Per Cent. of Special Causes.	Per Cent. of Known Causes.
Candy Boiling	12	17.2	8.0
Cocoa Grinding	8	11.4	5.3
Dry Room	4	5.7	2.7
Cocoa Roasting	11	15.7	7.3
Sugar Mill	14	20.0	9.3
Chocolate Coating Machine	2	2.9	1.3
Packing	4	5.7	2.7
Candy Heating Machine	1	1.4	.7
Chocolate Dipping Table	1	1.4	.7
Miscellaneous	13	18.6	8.7
Total	70	100.0	
Common Causes	73		48.6
Special Hazard Causes	70		46.7
Incendiary	1		.7
Exposure	6		4.0
Total known causes	150		100.0
Unknown causes	65		
Total	215		

Details of Causes.

Under this heading are given brief descriptions of fires caused by unusual conditions or of an educational value in emphasizing the different hazards. Fires caused by ordinary conditions or well understood hazards may not be included.

Common Causes.

Boiler (or Fuel).

H-2. Woodwork in front of a boiler was not sufficiently protected; live coals from the ash pit fell out on a wood floor during the night and fire ensued. The watchman was out getting a lunch. Leading from the boiler room to the top floor was an open elevator shaft and stairway which allowed fire to spread to the roof.

S-11214. Ashes from a boiler burned through the floor, falling into a storage room in the basement directly below, and set fire to the stock of excelsior stored there. One sprinkler operated and extinguished the fire.

Rubbish (or Sweepings).

S-4438. Scrapings and sweepings were carelessly placed in a wooden barrel where they ignited from spontaneous combustion. One sprinkler opened and extinguished the fire.

S-20079. Fire started in a barrel of sweepings in rear of basement, probably from spontaneous combustion. One sprinkler opened and put out the fire, but the water damage exceeded $1,300.

Special Hazard Causes.

Candy Boiling.

H-2312. Syrup was being boiled in kettles resting on proper bases. During the temporary absence of the attendant syrup boiled over and was ignited by the furnace. The surroundings were highly inflammable, but the quick application of water from high pressure plugs confined the fire to the floor of origin.

S-20132. Sugar boiled over onto a hot plate and ignited. One sprinkler operated for ten minutes and completely extinguished the blaze. The water was taken care of by a self-draining floor and scuppers, so that the damage to stock by water was but $30.

Cocoa Roasting.

S-23651. Hot beans from the roaster were put in a metal truck having a screen bottom and were placed over a suction duct so that cool air could be drawn through the beans. The draught ignited a spark in the beans and set them afire. The fire was extinguished by chemical extinguishers before sufficient heat was generated to open the high test sprinkler heads installed above the roasters.

S-3113. The cocoa roaster was heated by gas, the cocoa beans being kept in agitation inside a revolving sheet iron drum. The driving belt caught and the drum stopped, but was immediately started again. The beans ignited at this time and burst into flame a little later, when the charge was placed in the draught of a blower.

Sugar Pulverizing.

H-9503. Foreign substance in some broken candy being reduced in pulverizer struck a spark and ignited the sugar dust.

S-16549. An explosion and fire in sugar dust were caused by a spark or hot bearing. Similar explosions had occurred previously on this same machine when the cover of the metal separator was opened, allowing air to enter. This separator was subsequently disconnected from the mill, the sugar discharging direct to the bins. An automatic blow-out valve, discharging to the outside of the building, was also installed at the machine.

S-19680A. Fire followed an explosion of sugar dust in a pulverizing machine. A flue that had been installed for the purpose of taking the flame outside the building in the event of such explosions was provided with a sliding door. This door was open at the time, allowing flame to extend into the room. Damage by fire and water resulted.

This loss could have been avoided had the sliding door not been carelessly left open.

Cocoa Grinding.

H-8020. Cocoa in block form was put into a pulverizing machine. When it was ground fine enough it was conveyed by a blower system through an eight-inch pipe to a cyclone collector. From this point the cocoa was forced through a circulating system of galvanized iron pipe located in the cold storage room on the floor

below, which process had the effect of setting the color. An explosion occurred in the dome of the collector, opening up the joints and setting fire to some bags of cocoa nearby. Fire also communicated to the circulating system on the lower floor. The explosion was caused by a spark of undetermined origin which ignited the cocoa dust in the collector.

S-15910. In this installation the ground cocoa was passed through a blower system to cool and dry it and was then separated in cyclone separators. The exhaust air from the cyclones was run into a small dust room, partitioned off from the main room by cloth-covered wooden frames. Presumably from friction in one of the blowers, the dust in the blower piping and dust room became ignited and an explosion took place which destroyed the walls of the dust room, pulled the blower piping apart, and blew out the windows of the main room. The explosion was followed by but little fire, although the first flash opened sixteen sprinklers. These extinguished what fire there was, and the tight asphalt floors and interior drains kept the water loss at a minimum.

Dry Room.

S-19615. Gum drops were dried in a wooden dryer about 10 feet square and six feet high. During the winter steam from the heating mains had been used to heat the dryer, but with the approach of warm weather this supply was discontinued and some other method had to be substituted. A workman employed by the company installed a small coal stove in the drying enclosure and carried the smoke pipe through the top and placed the upper end in a ventilator which led from the space between the top of the dry room and the ceiling through the next floor and roof. The ventilator pipe was about six inches in diameter with soldered joints, the smoke pipe being two inches smaller, which left a space between them. It is evident that on the afternoon of the fire sparks fell back through this space onto the top of the dry room, setting fire to it. Five sprinklers operated and held the fire in check until the arrival of the fire department. The sprinklers would probably have completely extinguished the fire if the area within the dry room had been sprinklered. Loss, mostly by water, about $4,750.

Miscellaneous.

S-2387. A small loss was caused by a fire in a tank of preserving mixture used for dipping chocolate cakes. This mixture was a vegetable gum cut with alcohol. In lighting an open gas jet over the tank, part of the match or tip of the jet fell into the mixture, setting fire to it.

H-10120. In this factory there were forty or fifty bags of hulls from cocoa beans stacked against some steam pipes. Apparently the heat from the pipes started the fire. Loss, $10,000.

MISCELLANEOUS STATISTICS.

2. Analysis of Loss.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
No Claim	19	28	13	20	3	5	35	18
Small Loss	37	55	46	69	30	49	113	58
Large Loss	11	17	7	11	28	46	46	24
Total with data given	67	100	66	100	61	100	194	100
No data	6		4		11		21	
Total	73		70		72		215	

3. Day or Night Fires (Day Fires 6 a. m. to 6 p. m.)

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Day	28	39	37	53	18	26	83	40
Night	43	61	33	47	50	74	126	60
Total with data given	71	100	70	100	68	100	209	100
No data	2		0		4		6	
Total	73		70		72		215	

4. Plant in Operation.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Plant in Operation	22	40	45	71	16	25	83	46
Plant not in Operation	33	60	18	29	47	75	98	54
Total with data given	55	100	63	100	63	100	181	100
No data	18		7		9		34	
Total	73		70		72		215	

5. How Discovered.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Employee	18	33	37	59	17	26	72	39
Watchman	8	15	5	8	7	11	20	11
Sprinkler Alarm	14	25	10	16	13	20	37	20
Thermostat	1	2	2	3	2	3	5	3
Outsider	14	25	9	14	26	40	49	27
Total with data given	55	100	63	100	65	100	183	100
No data	18		7		7		32	
Total	73		70		72		215	

SPRINKLER FIRE RECORD.*

6. Effect of Sprinklers.†

	No. of Fires.	Per Cent.
Extinguished or Practically Extinguished Fire	72	73 5
Held Fire in Check	25	25.5
Unsatisfactory	1	1.0
	98	100.0
No Claim	21	21.4
Small Loss	68	69.4
Large Loss	8	8.2
No data	1	1.0
Total	98	100.0

* There were 15 fires in which no sprinklers were opened.
† Four fires included in this table are omitted from subsequent tables owing to insufficiency of data.

7. Number of Sprinklers Opened.

No. of Sprinklers Operating	Extinguished Fire		Held Fire in Check		Unsatisfactory		Total	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
1	30	42.2	6	27.3	..	..	36	38.3
2	14	19.7	4	18.2	..	..	18	19.2
3	9	12.7	5	22.8	..	..	14	14.9
4	6	8.5	2	9.1	..	..	8	8.5
5	..	..	2	9.1	..	..	2	2.1
6 to 9 incl.	9	12.7	1	4.5	..	..	10	10.6
10 to 24 incl.	2	2.8	..	..	..	..	2	2.1
25 to 49 incl.	1	1.4	1	4.5	1	100.0	3	3.2
50 and over	..	..	1	4.5	..	..	1	1.1
Total	71	100.0	22	100.0	1	100.0	94	100.0

Points of Interest from Fire Reports.

Automatic Sprinklers.

S-2635. Fire, supposed to have started from a spark from the commutator, was discovered by the watchman in the motor room. He rushed out to turn in an alarm. About nine feet distant, but with a large wood girder between it and the fire, there was a sprinkler head which had not yet opened. While the watchman was out this sprinkler operated and held the fire in check, but, because of the wood girder, the water could not reach the fire on the ceiling. The city fire department extinguished the fire.

S-9654. A fire on the second floor apparently originated in a chocolate coating machine from the gas jets which were left burning at all times to warm the chocolate. It spread to the wooden cone pulleys, then to a canvas belt, and to the floor, getting into the hollow spaces in the floor and spreading over an area of 50 square feet before being extinguished. The flooring in that section of the building consisted of two one-inch floors about two or three inches apart, supported on joists with a boarded ceiling below. Two sprinklers were opened by the fire, one on the first and one on the second floor. They were supplied by a gravity tank of 8,500 gallons capacity which gave a pressure of about 25 pounds on the heads which operated. This tank was completely emptied as the city fire department could not locate the controlling gate valve. The sprinklers were a factor in checking the fire. Although the head which opened on the second floor was about 11 feet distant, it flooded the floor and prevented the fire from burning through. The sprinkler which opened on the first floor was directly under the place where the ceiling burned through and checked the fire at this point. Seven or eight sprinklers on the second floor fused, but did not operate. Two of these were directly over the fire. Investigation showed that they were dirty and had been painted with a moderately thick coat of paint. This condition, together with the low pressure, accounted for their failure to operate.

S-20559. Sawdust was used for soaking up the oil at motors and was then placed in a wooden barrel. The cause of the fire was probably spontaneous combustion, as the watchman found the contents of this barrel smouldering. He threw several pails of water on the blaze and had apparently extinguished it. Later he found the material again burning and fully extinguished the fire with a line of hose from a standpipe, taking care to use no more water than was necessary so as to prevent water damage. No sprinkler heads operated, as some time previously a partition had been erected, obstructing several sprinklers and forming a space not covered by sprinkler protection. The barrel of rubbish was in this space at the time of the fire.

S-16519. Fire originated in the storeroom of the factory and was probably caused by smoking. Six sprinklers opened and confined the fire to the room of origin. The building loss was small, but the water loss large, owing to the poor location of the tank valve, which could not be closed until the tank was nearly drained.

S-17748. Fire occurred in a cold air chocolate room on the fifth floor, originating from an unknown cause in a rack of finished chocolate drops. The watchman, who was in the basement, heard the sprinkler alarm and upon investigation discovered smoke issuing through the crevices of the chocolate room door. The room was always kept locked and the watchman did not cover it during his rounds. Forty-eight sprinkler heads, the total number in the room, operated, although the fire was confined to a small frame rack of light construction. This unusual action was caused by the peculiar construction of the room. It had frame sides with a three-inch cork insulation on walls and ceiling, finished with about an inch of cement. All windows to the outside of the building were of wired glass with secondary windows inside. Because of the tightness of construction and the cement finish, the heat from the blaze quickly permeated the room, fusing all of the heads before water was available to the sprinkler system from the dry valve in the basement.

Watchman Service.

S-16841. One sprinkler had opened and extinguished a small fire, and the water had been running for some time before the watchman discovered anything wrong. There was no alarm bell and the watchman did not make regular rounds.

S-20335. A fire of unknown cause occurred in a stack of baled excelsior stored on the loading platform. The watchman heard the local alarm bell, located the fire, and, supposing it extinguished, closed the valve controlling the sprinklers in that section. The fire again broke out and, instead of reopening the valve, the watchman attempted to call the city department through a public box. He failed in this, so he returned and opened the valve. By that time the heat had fused all the heads in the loading area and two inside the building. All the water in the pressure tanks and half of that from the gravity tank was discharged through the large number of sprinklers which opened. The loss was $5,000, mostly water damage.

Horizontal Openings.

S-13729. The manufacturing building was equipped with sprinklers, but a storehouse in the rear was not sprinklered. It was the custom to take all sweepings, waste paper, etc., to the boiler room to be burned under the boiler. A considerable amount of sweepings had been carried to the boiler room and the engineer proceeded to shovel them under the boiler. He threw in a shovelful of waste paper in which was a heavy string which clung to the shovel when he drew it back, pulling some of the burning paper onto the floor. Other paper on the floor caught fire at once **and the flames spread to the storehouse through an open fire door.** Sprinklers in the main building and fire doors between the main building and the

storehouse protected this part of the property. There was a loss, however, of $3,800 on the storehouse and its contents.

H-1037. This building was divided into two sections by a fire wall. The fire occurred on the second and third floors of one section, doing considerable damage. A fire door recently installed at the opening in this wall prevented the fire from communicating to the other section.

H-512. Hot ashes in a confectioner's stove caused a fire which ignited the flooring underneath and worked through to the story below, near the wall. The heat passed through a shaft hole in the wall, operating a thermostat and two sprinkler heads in the adjoining building. The first notification of the fire was given by this apparatus. The fire also worked through the upper floors and roof, but was confined entirely to the building in which it originated. The sprinklers in the adjoining building prevented the fire from passing through the shaft hole, and standard fire doors on the fifth floor kept the flames out at that point.

Vertical Openings.

H-8740. This building was without any protection after business hours. The plant was closed at 8 p. m. and about 10.20 p. m. smoke was discovered coming from the building. An alarm was turned in from a street box and immediately afterwards the entire building, including the cellar, was in flames, due no doubt to the fact that the fire had been burning a long time before discovery. The cause of the fire is unknown. Apparently the blaze started in the cellar, worked up to the first floor, and was then drawn up an open elevator shaft, whence it spread through the different floors. The structure was formerly a church building, three stories in height. Upon the change of occupancy the interior was reconstructed for manufacturing purposes and an additional story built on the old walls. The floor supports were heavy wood girders and wooden posts, nearly all of which remained in position after the fire, although most of the flooring was destroyed. At the height of the fire a large girder in the cellar failed, thus permitting some of the supports above to fall. These supports were not self-releasing and one of them in falling ruptured the rear wall, pushing a portion down into a narrow street where some of the firemen were working. Three of the men were killed and a number of others injured.

H-11970. A fire of unknown origin had gained such headway before it was discovered by the watchman that the entire building was destroyed, in spite of the efficient work of the city department. The flames spread rapidly from the first floor to the fourth and fifth floors up the stair enclosure which was without doors. Shortly afterwards the second and third floors burst into flame. There was no protection to the dumb-waiters at the openings of their enclosures and this condition undoubtedly helped further to spread the fire.

S-6080. A fire started in the basement of a seven-story building near an open elevator shaft. The sprinkler system was an old installation with the heads spaced 10 feet apart and not staggered.

Except for the open shaft the sprinklers would without doubt have held the fire in check or even completely extinguished it. But the flames were carried by the draught to the elevator shaft and spread rapidly throughout the building. This opened a large number of sprinklers, reducing the pressure and quickly draining the gravity tank. When the fire was discovered the upper floors were already in flames. Twenty-one hose streams and a fire tower were used and extinguished the fire after the fifth and sixth floors had been completely burned out. Although the sprinklers failed to put out this fire, the fundamental cause of the serious loss was the unprotected vertical opening.

Thermostats.

S-15888. The watchman heard the sprinkler alarm and turned in a public alarm at the street box. The fire was held in check by the sprinklers until the arrival of the city department. The thermostat installed in the dry room where the fire occurred did not send in a signal until 10 minutes after the public box was pulled. This instrument was set to give a local signal when heat dropped to 200 degrees F. and a fire signal at about 300 degrees. The 286 degree sprinkler probably operated before the thermostat did and the water from this sprinkler kept the thermostat cool and prevented it from sending in a signal.

Fire Department.

S-5496. The building in which the fire occurred was a four-story brick joisted structure, used for the manufacture of candy. It was equipped with sprinklers. Adjoining one corner of this factory there was a four-story brick vault, 20 feet square, which was unsprinklered. The fire started on the third floor of the vault, used for the storage of fireworks. The foreman, looking for the cause of the smoke, opened the patented double iron doors to the vault. Immediately there was a mild explosion and a rapid combustion of the fire works, and he was unable to close the fire door. The flames shot out of the vault across the factory, which was but 32 feet wide, and up the open elevator shaft to the fourth floor. Twenty-seven sprinklers were opened on the third floor and 19 on the fourth floor. They operated satisfactorily and prevented the fire from doing any damage in the main building. Shortly after the fire department arrived the manager saw that the fire was out, shut off the sprinkler system, and requested the fire department to stop throwing water into the building, but his request was disregarded. This was a quick, hot fire, well controlled by the sprinklers, and the loss was largely increased because of the excessive water damage, due to the inefficient work of the fire department.

S-6562. From the fact that only the sprinklers below the floor opened, it is probable that this fire, which was of unknown origin, started in the ceiling and worked through the floor above. Fire did but a small part of the damage. A large quantity of cocoa beans was piled on the upper floor and caused a large amount of smoke. This led the firemen to think that it was a large fire. Accordingly they

used an unnecessarily large amount of water, which ran down through the floors and caused an excessive damage.

Radiated Heat.

S-17283. The roasters used for cocoa beans were iron rotary furnaces, brick set and coal fired. The floor under and about the roasters was two-inch by six-inch plank set on edge with a one-inch top flooring. On top of the wood was a sheet iron covering and on this was laid one course of brick four inches thick with cement mortar setting. It was the custom when shutting down on Saturday nights to draw the hot coals from the fire boxes onto the brick floor and wet them down with a hand hose. The furnace man evidently neglected to wet down the ashes from one of the furnaces, and the heavy body of hot coals heated through the brick and brought the temperature of the metal covering up to the point where it ignited the wood under it.

S-20584. This factory had 18 roasters of the coal-heated type. The bottom of the ash pits consisted of ⅜-inch iron plates laid on brick eight inches thick. The brick was set on one inch of cement. Beneath the cement was a one-inch top flooring and a heavy plank floor. The brickwork under the ash pits contained several four by six-inch air channels for cooling the floor beneath. Due to almost continuous running of the roasters, the heat had passed through to the wood flooring, which gradually charred and finally ignited. The blaze was extinguished with chemical extinguishers before there was sufficient heat to operate any sprinklers.

EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS.	Number and Per Cent. of Fires.								Average Pressure.			Average Number Sprinklers Opened.	
Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory		Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Water works,	39	41.5	63	3.55	31	79.5	7	17.9	1	2.6	66	52	60	3.61	3.29
Gravity tank,	13	13.8	31	3.31	9	69.2	4	30.8	..	..	37	17	..	3.22	3.50
Pressure tank,	41	43.6	89	5.68	30	73.2	11	26.8	..	..	92	81	..	3.87	10.62
Automatic pump,	1	1.1	80	2.00	..	...	1	100.0	..	..	..	80	..	...	2.00
Total	94	100.0	70	4.44	70	74.5	23	24.4	1	1.1	74	61	60	3.67	6.79

EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS.	Number and Per Cent. of Fires.								Average Pressure.			Average Number Sprinklers Opened.	
Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory		Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Less than 15 lbs.,	3	3.2	11	3.67	..	...	3	100.0	..	...	..	11	..	...	3.67
15 to 24 inclusive,	4	4.3	19	2.00	3	75.0	1	25.0	..	...	19	20	..	2.33	1.00
25 to 49 inclusive,	15	15.9	36	6.80	10	66.7	5	33.3	..	...	36	36	..	8.10	4.20
50 and over,	72	76.6	83	4.11	57	79.2	14	19.4	1	1.4	83	84	60	2.97	8.79
Total	94	100.0	70	4.44	70	74.5	23	24.4	1	1.1	74	61	60	3.67	6.79

EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS.	Number and Per Cent. of Fires.								Average Pressure.			Average Number Sprinklers Opened.	
Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory		Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Wet system,	76	80.9	71	2.99	57	75.0	18	23.7	1	1.3	74	60	60	2.28	5.22
Dry system,	18	19.1	69	10.50	13	72.2	5	27.8	..	..	71	66	..	9.78	12.40
Total,	94	100.0	70	4.44	70	74.5	23	24.4	1	1.1	74	61	60	3.67	6.79

EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS —As Regards Amount of Loss.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Water works,	39	41.5	63	3.55	5	12.8	33	84.6	1	2.6	58	64	60	2.00	3.79	....
Gravity tank,	13	13.8	31	3.31	3	23.1	8	61.5	2	15.4	35	34	12	1.33	4.12	3.00
Pressure tank,	41	43.6	89	5.68	13	31.7	24	58.5	4	9.8	91	90	78	1.62	2.37	38.75
Automatic pump,	1	1.1	80	2.00	..	...	1	100.0	..	...	..	80	..	..	2.00	....
Total	94	100.0	70	4.44	21	22.3	66	70.2	7	7.5	75	70	57	1.67	3.29	26.83

EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS —As Regards Amount of Loss.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Less than 15 lbs.,	3	3.2	11	3.67	..	..	1	33.3	2	66.7	..	9	12	....	5.00	3.00
15 to 24 inclusive,	4	4.3	19	2.00	1	25.0	3	75.0	..	...	15	20	..	1.00	2.33	....
25 to 49 inclusive,	15	15.9	36	6.80	2	13.3	12	80.0	1	6.7	27	37	48	1.50	4.25	48.00
50 and over,	72	76.6	83	4.11	18	25.0	50	69.4	4	5.6	84	82	81	1.72	3.08	35.67
Total	94	100.0	70	4.44	21	22.3	66	70.2	7	7.5	75	70	57	1.67	3.29	26.83

EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS —As Regards Amount of Loss.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Wet system,	76	80.9	71	2.99	17	22.3	55	72.4	4	5.3	74	71	56	1.59	2.53	19.33
Dry system,	18	19.1	69	10.50	4	22.2	11	61.1	3	16.7	80	69	57	2.00	7.09	34.33
Total	94	100.0	70	4.44	21	22.3	66	70.2	7	7.5	75	70	57	1.67	3.29	26.83

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.

Fires in Dye Manufacturing Plants.

In view of the rapid development of the dye stuff industry and the newness of the problems it has presented to the fire prevention engineer, it has been thought worth while to assemble the data as to fire causes reported in these plants since August, 1914, when the opening of the Great War gave the industry a great impetus in America. As far as possible the causes have been grouped under general headings. It should be added that the natural dyes, such as logwood, which make no figure in the new industry, have been excluded.

Aniline Oil.

H-13154. The fire was caused by the bursting of a direct-fired aniline oil still. The rupture allowed the oil to flow over the floor and into the fire box. The burning oil spread the fire to adjoining buildings.

H-13956. In this factory aniline was treated with hydrochloric acid in a gas-heated oil bath. The oil became ignited from some undetermined cause. About two months previously a similar fire had occurred and it was thought at that time that defective piping had allowed aniline to leak into the oil bath.

S-21478. Aniline sulphate was made by mixing aniline oil with sulphuric acid in open iron pans. An employee was pouring aniline oil from an iron can into a pan containing the sulphuric acid when the vapor from the oil took fire (possibly from an open torch or match carelessly used by an employee) and ignited the wooden fume chamber overhead.

Autoclaves or Kettles.

H-12093. A closed steel autoclave was used for the saponifying of dinitrochlorbenzol. During the process about 2,000 pounds of sodium salt of dinitrophenolate was sublimed on the top of the inside of the tank. These salts exploded from some cause not satisfactorily determined. No fire followed the explosion.

S-20657. A nitrator, in which mono-nitrotoluol was being treated with mixed acid to obtain di-nitrotoluol, exploded with such violence that the heavy steel cover with the agitator and shaft, weighing about 3,000 pounds, was blown through the roof, and a large section of the side wall of the building was blown down. Fire followed the explosion.

S-21679. Chlorbenzol was nitrated with mixed acid in autoclaves which were equipped with 2½-inch blow-off valves discharging above the roof. It was customary to run several hundred pounds of mixed acid into an autoclave and then allow chlorbenzol to flow in gradually from a tight steel tank at a higher elevation.

When the reaction had reached the desired degree, the finished product, binitrochlorbenzol, was separated from the spent acid and drawn off. As far as could be learned the usual charge of acid had been drawn into one of these kettles and soon after the admission of chlorbenzol a violent chemical reaction took place. Although the blow-off valve opened, the pressure became so great that the gaskets at the top of the kettle and at the manhole cover blew out and allowed the material in the kettle to discharge into the room and ignite.

S-21704. As nearly as could be ascertained, this fire was caused by nitrotoluol accidentally getting into a tank of mixed acid. Binitrotoluol was made in an autoclave by admitting nitrotoluol and then allowing a measured charge of mixed acids to enter by gravity. The piping provided for the nitrotoluol and the acids was interconnected and when the nitrotoluol was admitted some of it backed up through the piping and valve into the acid measuring tank. A violent reaction took place and the pressure was raised sufficiently to blow out a plug in the vent pipe from the tank. The escaping gas took fire upon reaching the air and ignited the roof.

Benzol.

H-11590. Benzol vapor from sulphonating kettles was ignited, probably by an electric spark from a direct current motor nearby.

H-12973. Benzol which had run on the floor from a leaking chlorinator was ignited when an unprotected electric light bulb on an extension cord was accidentally broken.

H-13904. The vapors from an overheated benzol sulphonating kettle caused an explosion.

Drying.

H-14071. The colors manufactured at this plant were various. The manager of the factory stated that some of them, which were highly inflammable when dry, were not subject to fire when they contained a small percentage of moisture. The color which caused the fire was a brown which the plant had been manufacturing for some little time, but only recently had the water been extracted from it and the color reduced to a powder. A workman was removing iron trays containing the color from a drier and emptying the contents into a barrel ready for packing when the flash occurred. The drier was run at a temperature of 140 degrees F. and the color had not been allowed to cool before starting to remove it. The color was heavy and practically no dust was formed when the trays were emptied. The material was caked and the workman was using a metal scoop to break the lumps and scrape out the trays. It is suggested that either enough heat was generated by the friction between the color and the metal to ignite the former or that a spark resulted from the contact of the scoop and the metal tray.

S-20896. Fire occurred in a steam-heated drying oven in alphanaphthylamine on wooden trays. The trays may have ignited from direct contact with the steam pipes or spontaneous heating of the stock, started by the initial heat of the oven, may have caused the fire.

S-22227. A smouldering fire, which destroyed a considerable amount of color, occurred in a steel-clad drier where methyl-blue was being dried for finishing. The drier was heated by hot water pipes and a thermostat was set to keep the temperature at 112 degrees F. It is supposed that the color heated spontaneously, although it was claimed that several thousand pounds of this color had been made previously and no trouble experienced.

Fuel Oil System.

S-19270. This fire was caused by the breaking of a brass globe valve on the supply line to one of the oil burners used to heat the autoclaves in which naphthalene and very strong sulphuric acid (oleum) were mixed. The oil flowed into the room and ignited at the torch which was kept lighted at each oil burner. Although exposed to considerable fire several thousand pounds of naphthalene present did not take fire.

Lamp Black Manufacturing.

H-11695. In the process of making lamp black, dead oil was allowed to drip to burners under a boiler. The dead oil was a coal tar or creosote oil from which the heavier ingredients such as phenol and naphthalene had been removed. The burning oil was passed through a boiler containing water to cool the smoke and aid the deposit of lamp black. The lamp black thus formed circulated through a series of large fire-resistive chambers and finally settled to the floor, where it was allowed to collect. It was then removed and barrelled. Frequently small puffs or flash-backs occurred at the furnace, and sometimes mild explosions occurred in the chambers. These had always been taken care of successfully by the roof vents which had opened and relieved the pressure. This time, however, the explosion was so violent that, although all the vents opened, the walls of some of the chambers were blown out. No satisfactory reason could be given for the explosion, unless it was assumed that carbon monoxide had collected in sufficient quantity to form an explosive mixture.

Miscellaneous Common Causes.

H-11945. A lantern and torch were used to thaw out the tank drop from a gravity tank. A small fire was started in the rags used for packing the drop.

H-13831. A fire occurred in the stable of this plant. The owner believed it to be incendiary.

H-14239. It is alleged that faulty insulation on the electric wiring set fire to the roof joists near a dust collector.

S-20586. In this plant a stock drying furnace was so located that the front wall of the building formed the face of the furnace and the fire and ash doors were on the outside of the building. A wooden conductor pipe had its outlet at a point near the furnace. When an employee cleaned the fire some hot coals got into the pipe and the draft caused the flames to spread up this natural flue.

S-21058. Fire of unknown origin set fire to a wooden bench and drawers in a small chemical laboratory.

Miscellaneous Special Hazards.

H-11898. A ladder being used by workmen fell, breaking a gallon bottle about half full of sodium bisulphite solution. The contents of the bottle apparently fell into an open barrel of chlorate of soda which was standing nearby. A violent chemical reaction ensued and almost immediately flames were seen issuing from the barrel. It was considered probable that the reaction of the sodium bisulphite with the sodium chlorate liberated chloric acid, free oxygen, or both. It was thought that the chloric acid, if any were present, may have caused some organic matter, such as paper, to ignite spontaneously. In any event, the presence of free oxygen would have made it possible for the heat of the reaction to produce a fire. The great rapidity with which the flames spread seemed to prove the presence of free oxygen. As there were six other light wooden kegs, each containing about 110 pounds of chlorate of sodium, next to the open one, much of the oxygen may have been liberated by the decomposition of this material by the heat.

S-23452. The cause of this fire is not known. It was thought to have started near the place where 30 barrels of alizarol brown were standing open. Dust from this color had settled on the ceiling and walls in a thick cover. This condition was probably responsible for the prolonged flash which spread the flames throughout the building.

Pulverizing.

H-14188. Dried chrome yellow was being ground in an impact pulverizer grinder. The fire started in the grinder, caused probably by a nail or other foreign matter in the material being ground.

S-20949. Fire probably originated from a spark struck in a ball mill by some foreign substance in the brown color which was being ground. The flash from this mill set fire to the color in a number of others. The flame, similar to a large blow-torch, extended 60 feet across the room and was prevented from starting a very extensive fire only by the prompt operation of the automatic sprinkler system.

S-22209. This fire was probably caused by a nail or other piece of metal in the grinding mill. There was a slight explosion and a flash which set fire to a balloon dust collector.

S-22830. Alizarol yellow was discharged from a pulverizing mill directly into a mixer. In order to relieve the air accompanying the discharge and to keep the finely divided color from coming out into the air of the room, the covers of the mixers were made airtight, but a vent was provided which had a cloth balloon about four feet in diameter with a return pipe to the grinder. Fire was struck by a bolt which accidentally got into the mixer and out to the balloon, where a mild explosion took place because of the quick burning of the finely divided color suspended in the air. A quick hot flame flashed through the room and to the floor above.

S-23109. A nail in some alizarol yellow which was being ground is thought to have started this fire in the mill. The flames spread from the grinding mill throughout the second floor of the building and up through the belt holes and chutes to the third floor.

S-23270. Dry alizarol yellow was being ground in open spherical ball mills, when either friction or a spark caused by some hard or flinty foreign substance in one mill set fire to the color. The puff of flame from that mill evidently caused flares of fire from four or five others. These flares were said to have projected over 100 feet toward the east end of the building. Small woodwork, inflammable fixtures, and some color in open containers were set on fire.

SE-2. This fire started in a ball mill from an undetermined cause. The color being ground was a metachrome brown.

Smoking, Sweepings, Hot Ashes, Etc.

H-13467. Hot ashes were piled against the side of a wagon shed.

H-14024. A small fire occurred in a wooden truck of woodworking refuse in a carpenter shop at the plant. It was thought that the fire might have been caused by smoking or by the careless use of matches.

S-20316. Spontaneous ignition is supposed to have started this fire in a large galvanized iron waste can, containing refuse packing materials, such as straw and excelsior, and miscellaneous waste chemicals.

S-23153. A match or lighted cigarette carelessly thrown into a barrel of naphthalene set it afire.

S-23839. Fire occurred in warehouse sweepings which had been put in a wooden barrel which was set outside the building. This refuse probably contained such materials as zinc dust, sodium nitrate, etc. It was thought that a light rain falling on the mixture caused it to ignite spontaneously.

Spontaneous Combustion.

H-23559. In the process of making sulphur blues an intermediate material, nitrosophenol, was produced by treating phenol with sodium nitrate. The process ended with vacuum drying of the nitrosophenol which was then stored in powder form in open barrels. Four times within a period of about two weeks fires occurred in barrels of this substance. It was said that these fires started spontaneously. The plant chemist was credited with the opinion that, when in a dry powdered state, nitrosophenol will burn fairly readily, giving a smoky flame; that in a pure state it is not subject to spontaneous ignition or heating; and that the fires could be accounted for only by the presence of impurities—probably from so-called "tarry matters" in the raw phenol used. All the fires occurred in the material made from one lot of phenol.

Film Exchange Fire, Salt Lake City.

April 17th, 1919.

Special Report by Fire Prevention Bureau of the Pacific, I. W. Story, Branch Manager.
(Member N. F. P. A.)

The building has a frontage of about 295 feet on the south side of Exchange Place (a street 66 feet wide), and has a depth at the west end of about 83 feet on Cactus Street and at the east end of about 90 feet on State Street. It is a one-story and basement ordinary joisted brick structure with tar and gravel roof. It is divided near the center by a brick wall, and sub-divided into 17 stores by brick walls in basement and 3-inch block (gypsum) partitions plastered on both sides, at first floor. There is a low blind attic. Basement floor is of concrete; floor above double wood, the wearing floor being maple. There are open stairs to basement. A wood lath and plastered ceiling in the first story, open joists in the basement. About 90 per cent of street front is glass. Area is about 24,310 square feet.

The occupancy consisted of six film exchanges, a typewriter agency, a yeast agency, an electro-plating plant, a decorating company, a printing shop, an automobile sundry and service station, an electric fixture store, a pool parlor, a rubber sundries store, bakery and a barber shop. The Pathé Film Exchange occupied the store No. 64 Exchange Place, near center of building, the area being approximately 1150 square feet. The offices in front are divided by low railings and light 6½-foot frame and glass partitions (no ceilings); separated from inspection and shipping room by the film vault and a light wood paneled frame partition with top lights hinged for ventilation, and an ordinary wood door. The film vault 8½ x 14 x 7 feet (833 cubic feet) used the gypsum block store division wall for one end, the other three walls and ceiling being constructed of the same material and cement plastered on both sides; building floor covered with metal was used for floor of vault; one opening was provided with an ordinary metal clad non-automatic door; the vault was vented from ceiling to outer air through a horizontal riveted metal pipe 8 inches in diameter and 30 feet long. One nitrogen lamp in vault attached to a long reinforced cord which led through the door of vault to an outlet above vault in ceiling of store, was not provided with a dust proof globe nor a wire guard. Films were wound on metal reels, not kept in individual containers, but piled side by side in racks made of flat iron uprights and pipe horizontals around sides of—and one tier in center—of vault. A picture machine for running reels was used in frame room in basement. Advertising matter was also stored in basement in frame shelves. Two of the other exchanges, the Western Triangle Distributing Corporation, No. 58 Exchange Place, and the Universal Film Exchange, Inc., No. 56 Exchange Place, have

vaults of same construction, but better lighting systems; the balance have no vaults except one, which has an ordinary metal clothes locker.

The Fire.

Fire was discovered in the film vault, and no doubt started from either a short circuit of the electric cord or the direct heat of the electric globe in contact with films. As explained by the shipping clerk, he had just returned from the street with the rubbish barrel and put it near the vault in its usual place. Stepping to the rear, turned around facing the vault, he noticed smoke coming from the vault, as the door to same was open, and upon investigating, found that several reels were on fire to his right. He rushed out and part way to the front of the store shouted a warning that the place was on fire; then he ran to the rear, past the vault to the stairs leading to the basement and again shouted to two girls who were in the basement to come up and get out as there was a fire; the stenographer left by the front door, the balance of employees by the rear door, one girl and the shipping clerk being the last to get out just as an explosion took place which slightly burned the girl about the face and the shipping clerk quite severely about the face, slightly injuring one eye.

The explosion blew out about 55 square feet of the front (north) wall of the vault facing the office and probably some of the windows; the resulting fire destroyed practically everything in the exchange, including 1,100 reels of film in the vault. A large amount of advertising material and a moving picture machine in basement were, however, only slightly damaged by water. About 400 reels of film including some of the more expensive, were out. It is stated that there were not more than a dozen reels of film on inspection tables in the shipping room at the time of fire. A 2½-gallon chemical extinguisher near the door of the vault was not used and apparently was in good condition after the fire.

The heat cracked 3 plate glass windows and all but 3 or 4 of the prism top lights and blistered the paint on a similar building across the street which is 66 feet wide, and also destroyed the windows in stores adjoining each side of the exchange. Observers and firemen claim that the flames came out as though fanned by a blower and shot into the air at least 50 feet. The fire was confined to the exchange except that two automobiles, one standing at curb near front of exchange, the other across the street, were damaged considerably, most of the damage being to the upholstering and the tops.

Fire was fought and extinguished by the public department, the first alarm coming in by telephone, immediately after by box at 9:34 a. m. and in rapid succession by two other boxes, the usual equipment reporting promptly. Four hose streams were used direct from hydrants under hydrant pressure of 90 pounds from 6 and 8 inch mains, and fire was under control in less than 15 minutes, and entirely out, glass and debris cleaned up and department back in service in one hour.

Damage to the building where fire started is estimated at $3,000; to the building across the street at $800. The loss on films is questionable depending upon the popularity of same from a rental standpoint and the length of service.

Conclusion.

This fire again emphasizes the hazard of moving picture film exchanges, and the necessity for their proper construction, protection and maintenance.

All films should be stored in vaults of approved fire-resistive construction with self-closing doors. Special care should be observed in the construction of the vent pipe which should be of ample size, at least 16 inches in diameter. Vaults should preferably be sprinklered.

As few lights as possible should be installed (one to each 90 square feet being sufficient) in the vault, these should be wired in conduit (preferably concealed) with outlets in ceiling only and controlled by switch outside vault, should be provided with vaporproof globes and wire guards, should be approved by the city electrician before being used and absolutely no extension cords used, under heavy penalty.

All lights in examining room and about patching tables should also be provided with vaporproof globes and wire guards.

All films without exception should be kept in individual containers of approved type, with the proviso, however, that this does not apply to films in actual use or in process of inspection and repair or rewinding, but the number of these should be kept to a minimum.

This fire supports the contentions of the Fire Chief and the writer that Film Exchanges should not be located above the ground floor and should only be located in one-story buildings, and preferably buildings without basements. The Chief was instrumental in getting some of these exchanges to move into this one-story building from higher buildings, and only recently made an inspection of all the exchanges in the city and warned them to keep the vault doors closed, and made various other recommendations.

In addition to the above, this fire has clearly demonstrated that exchanges carrying large stocks of films in reserve should have two extra vaults of smaller size, one to keep reserve stock and the other for oprating (reels awaiting repairs, etc.) purposes.

Remarks.

Examining the vault after the fire it was found that the extension cord had been wrapped around the metal racks in several places and then forced in between the ceiling of the vault and the square-cornered metal framework of the film rack to make a good hold, then carried across the aisle at ceiling and likewise fastened to the framework again, then brought to the center and wrapped about itself to the proper length, evidently to have the light in the center of the aisle, but the key socket was at one side when found.

Courtesy Newark Evening News.

Dense black smoke was given off by burning liquids in Maas and Waldstein lacquer manufacturing plant fire.

Fire in a Lacquer Manufacturing Plant at Newark, N. J.

July 31, 1919.

Special Report by Captain C. Albert Gasser. (Member N. F. P. A.)

On Thursday, July 31, 1919, during the noon hour, an employee of the Maas & Waldstein Company, in Newark, saw fire around the machinery in a two-story brick building. Before the blaze was extinguished one-third the plant had been destroyed and the loss was estimated at $100,000.

The Maas & Waldstein Company manufacture lacquers and their processes begin with the nitration of cotton. They own a strip of land having 84 feet frontage on Riverside Avenue and running 500 feet east to the Passaic river on the extreme edge of the city limits and just north of a high railroad embankment. The location was as isolated as could be desired but this very fact doubled the loss because of the time necessary for fire apparatus to get there and because of the lack of water, there being only a six inch main available.

The building in which the fire started was destroyed, together with about thirty feet of a long one-story brick building, divided into parapetted units and a one-story concrete building. In addition to these buildings the fire consumed large quantities of benzol, fusel oil, alcohol, amyl acetate and finished lacquer, which had been stored in tanks and drums in the open. The heavy rolls of dense black smoke, pitted with

bright flame, made this one of the most spectacular fires in Newark in many months.

Many one-hundred gallon drums of benzol were ruptured, each one letting go with a bang, some of them blowing their heads off but none of the drums shifting as to position. All the liquid was consumed and as one drum after another added its contents to the fire, the mass resembled the cooking of a lot of eggs. Several ten-thousand gallon tanks of alcohol and fusel oil, mounted on wooden trestles, burned fiercely at fill pipes and vent pipes and finally fell to earth, empty, when the trestles had been burned away. None of these exploded.

Glass, lead, copper and iron melted in the intense heat. The direction of the wind kept the fire blowing toward the river and saved the western end of the plant from destruction. The establishment was worth about $300,000.

The firm formerly dried its cotton but by agreement with the Fire Prevention Bureau, this process was eliminated several years ago and instead, small batches of nitrated cotton were pressed and immediately dissolved into lacquer so that the fire brought no dry gun cotton hazard into play.

The plant was much too congested, the buildings were practically continuous structures and the storage of volatile liquids excessive, although in keeping with the plant output. This is one of the oldest establishments in the city.

No one was injured during the fire. This was extremely fortunate because some of the benzol drum heads shot through the air and fell dangerously near the firemen who were stationed on the railroad embankment.

The fire was due, as nearly as can be ascertained, to friction in a lacquer filtering machine through which the finished lacquer ran in its final process. It was not a vapor fire in its inception as the lacquer itself was burning when the fire was first noticed.

Canada Building, Winnipeg, in which wired glass windows withstood severe exposure fire (ruins in foreground).

Fire in a Furniture-Polishing Shop at Winnipeg.

July 11, 1919.

Special Report by Alex. Inch, Deputy Fire Commissioner. (Member N. F. P. A.)

This alarming and destructive fire started in the work-shop devoted to repairing, polishing or touching up of furniture.

As to the origin of the fire, the falling of a chisel from a tool rack caused a bottle containing alcohol to become broken, the fluid and vapor came in contact with the flames of a gas radiator nearby which was used for heating a glue-pot, when it ignited with a flash, and the fire spread very rapidly.

This building was at one time used as a curling rink, and on account of its wooden construction, its height and large area filled with furniture and other inflammable merchandise constituted a fire hazard of a very severe character.

The fire burned with great rapidity and threw a solid mass of flame to a great height, and the heat was so intense that for a time this section of the City was in danger of conflagration, and had there been a high wind at the time of the fire, nothing could have prevented the nearby buildings from becoming involved. As it was, a number of shingle roofs were ignited by sparks, and the wired glass windows in the

Canada Building exposed to fire were badly cracked. The fire burned out the wooden windows in the roof house of this building and ignited the roof over same.

The lessons to be learned from this fire are, that volatile inflammable oils should be kept in metal containers; that large area frame construction buildings are dangerous to adjoining or nearby buildings, with extreme danger of their becoming conflagration breeders with a high wind blowing.

The efficiency of wired glass windows as a fire stop was clearly demonstrated. The rear or west well of the Canada Building, a seven-story fire resistive structure, was subjected to extreme heat from the burning building, but the wired glass stood up in every case, and only the damaged frames and badly cracked glass show what they went through. Undoubtedly the wired glass was an important factor in holding the fire out of the Canada Building, but the fourth and fifth floors of this building would certainly have suffered severe loss by fire had not the occupants been in the building, as the heat passing through the glass started fires on both floors.

That the window openings in the roof house were unprotected and the wall not carried in parapet above the roof was a serious omission resulting from mistaken ideas of economy. The fact that fires were started in the building from heat radiation emphasizes the need of fire extinguishing equipment for first aid purposes in all buildings irrespective of their class of construction and occupancy.

The danger of several fires being started at once from sparks and flying embers falling on wooden roofs was again demonstrated.

Points of Interest from Fire Reports.

These notes are intended to illustrate conditions making for or against effective control of fire.

Automatic Sprinklers.

S-22113. Morocco Leather Works. Fire occurred in buffing room. Two buffers discharged to a concrete pit vented to a small corrugated iron box adjoining the building just outside the room, this box in turn being vented through a 4-inch metal pipe extending from the upper side of the box and looking down. Fire was confined to the dust pipe and boxes, but the heat was sufficient to open six sprinklers in the room and one outside. Probably the opening of so many sprinklers is explained by the fact that the equipment was a dry-pipe system. The damage was small.

S-22153. Drug House. Two sprinklers extinguished a fire in a chemical laboratory without loss. In this instance the sprinklers were of particular value, as the use of a hose stream would probably have involved the breakage of bottles of valuable chemicals.

S-22936. Automobile Factory. On the day of the fire a piper, without notifying anyone, had shut off the sprinklers in anticipation of

some extension work. When fire occurred, the condition of affairs was not discovered until 325 sprinkler heads had fused. The controlling valve was then opened, and although the large number of sprinklers operating caused an immediate drop in water pressure from 65 lbs. to 10 lbs., the equipment was an important factor, even with this scant pressure, in subduing the flames. The loss was between $8,000 and $10,000.

One of the results of this fire was that a "tagging" system was instituted at the plant.

S-23411. Oil Clothing Factory. Oiled goods which could not be accommodated in the fire-resistive building were hung in old frame dry rooms. One piece fell on the floor and became ignited. The sprinkler alarm operated promptly and extinguished the blaze before the firemen arrived. The loss was $418.

This fire is an excellent illustration of sprinkler efficiency, as the building in which it occurred was light joisted construction, thoroughly oil-soaked.

S-23575. Paper Mill. A hot bearing caused fire in a small matched board enclosure over a motor in a coal belt conveyor. A sprinkler head located in the enclosure fused, but failed to extinguish the fire owing to the fact that it had become plugged with oakum carelessly left in the piping by the men who installed the system. The fire then spread to the roof of a monitor over the conveyor and caused six more sprinklers to operate. The two heads nearest the fire at this point were also plugged, but the four more distant sprinklers were efficient in preventing the spread of the flames.

Investigation showed that the carelessness had occurred in making the lead joint at the connection between the underground main and the inside sprinkler work. When the sprinklers operated the flow of water carried the oakum to them. In all, about half a pound of oakum was removed from the pipes after the fire.

Alarm Service (Other than Watchman).

S-22223. Machine Shop. One sprinkler operated and entirely extinguished this fire, but owing to the clogging of the screen at the variable pressure chamber with scale and sediment, the alarm did not operate. Water was discharged for several hours before discovery and caused considerable loss. Patterns, drawings, tracings, tools and supplies were thoroughly soaked and most of the operating machinery was rusted.

S-22264. Clothing Factory. The sprinkler alarm in this case was connected only to a bell at the property. Whether this operated or not is uncertain, but the fire was not discovered until a policeman saw water running into the street from under the doors. Owing to the susceptible character of the stock the water damage was heavy, amounting to about $28,250. The fire damage was slight.

S-22327. Tannery. Fire was discovered by night watchman in boiler room, which was not cut off from the rest of the plant. The sprinkler system was crippled as a result of frozen water mains, but the

watchman attacked the fire with hand hose. Finding it beyond his control, he telephoned a member of the firm, who in turn telephoned an alarm without specifying the location of the plant. In this way twenty minutes were wasted. When the firemen arrived the fire had gained great headway, and owing to the frozen condition of the water mains little could be done to control it. The loss was nearly total.

S-22659. Cotton Mill. This was a picker fire. The picker tender notified the overseer in another room, and the latter tried to turn in an alarm from a public box. The box was found inoperative, however, as the result of corrosion of the key. It was therefore necessary to return to the mill and telephone. The damage amounted to nearly $2,500.

H-13671. Car House. Motorman and night man discovered fire in a car that had just been repaired, and started to fight it with standpipe hose, but without turning in an alarm. When they discovered that the flames were getting beyond their control they telephoned to the fire department, which, however, arrived too late to save the property. The loss was heavy.

S-23407. Harness and Fancy Leather. There was no alarm service of any kind at this sprinklered property. Consequently when three sprinklers operated to extinguish a night fire the water continued to be discharged until it was time to start work next morning. The water damage was considerable.

S-23466. Cotton Warehouse. The cock at the dry valve controlling the sprinkler alarm attachment was found closed after the fire, which was not discovered for about nine hours. The loss was $2,452, but would probably have been much smaller had the rotary gong not been put out of commission as mentioned.

S-23563. Canning Factory. Because of numerous false alarms the key was removed from a fire alarm box and keys were placed in the shipping room of this plant and in the office of a neighboring property. When need arose to send in an alarm the new arrangement was forgotten in the excitement of the moment, and delay resulted.

Watchman Service.

H-13238. Fertilizer Factory. When he discovered the fire watchman could, according to his own account, have extinguished it with water pails, with which the plant was equipped. He thought it best, however, to run to the office and telephone an alarm. He then went outside the plant to watch the fireboat approaching. He forgot to pull the public alarm box which would have called several engine companies who might have confined the blaze to a small area. The main factory group was gutted, and only very efficient work by the fire department prevented yet heavier loss.

H-13661. Paper Mill. A watchman of very limited capacity was employed at this plant. He seems to have attempted to fill his lantern while it was lighted, and in some way it got afire. In his excitement he carried the burning lantern some distance through the

building. He was severely burned about the hands and legs. An outsider saw the fire and telephoned an alarm while the watchman was making his way to the fire station. The property loss was $55,000.

S-13665. Saw Mill. Watchman either fainted or had a shock. It is supposed that in falling he overturned his lantern, as he was burned to death and his body was found lying beside the lantern. He was 67 years of age. The property loss was $44,215.

S-22978. Metal Worker. Fire occurred in a basement containing tools, dies and a large supply of ribbon steel rolled without oil or grease, each roll being covered with paper or burlap. The rotary gong connected to the sprinkler system operated and was heard by a policeman, who found the door of the factory unlocked and no one about. The policeman stayed at the factory all night. The watchman was found at home, and when questioned stated that he had been taken very sick after making his midnight round, and had no recollection of what he did after that. He was known to be a drinking man, and investigation showed that his keys were all detached from fastenings, screw head seals on boxes were missing, and the dials had received poor attention. There was a loss of between $6,000 and $8,000, mainly water damage.

S-23077. Mattress and Iron Bed Factory. A very high box car being pushed into a siding at this plant broke an overhead natural gas pipe between buildings, The switchman's lantern ignited the gas. Alarms were turned in by the switchman and an outsider, but the watchman, who saw the fire, was unaware of the fact that there was a public alarm box in the building and, not knowing what to do, went around and rang up four of the watchman clock stations to show that he was attending to his duties. He performed no service of value in connection with the fire.

S-23307. Fur Storage. The building was all ablaze when the fire was discovered. The sprinkler system had been shut off during the winter and not yet put into service again. At the time of the fire the temporary watchman was visiting with the watchman of a neighboring plant. There is reason to believe that he had been drinking heavily and that the fire may have been caused by smoking at a card party at the plant on the previous day (Sunday). The loss was total.

Miscellaneous.

S-22019. Oil Cloth Works. An oil kettle which was heated by an oil-fired furnace boiled over, and oil ignited, burning fiercely with dense black smoke. Chemical extinguishers had little effect, as the fire had gotten a good start before they could be used, and there were no sprinklers at this point. Fires at other kettles were extinguished in their incipiency without much difficulty. The heat at the roof was intense. Considerable concrete was spalled, exposing some of the reinforcing material. Vaporproof globes were softened and lengthened out into long, narrow tubes, but held together. The wired-glass windows nearby were badly melted, but held together and allowed no opening. All windows that were open closed automatically. The fire burned itself out when the oil in the kettle was consumed.

S-22050. Munitions Factory. Fire was caused by a lighted or glowing match thrown into an open pail which had been used for bringing benzine into the plant from an outside oil house. Steps were immediately taken to have a standpipe hose stream brought to bear upon the fire. As, however, the hose connection on this floor was supplied from the floor above, there was a pocket at the bottom of the pipe, in which considerable sand, etc., had collected. This was the point at which the hose connection was made, and consequently no water could be obtained through the hose after the controlling valve had been opened. In the meantime one sprinkler operated and extinguished the fire without loss.

S-22245. Potash and Lye Works. This was an exposure fire. An interesting feature was the ignition of cotton gloves used by the marker on a bench about twenty feet distant from a window. The fire in the exposing property had been gotten under control, and the manager started to make a round of the building to see if there had been any damage, and found the gloves smouldering. He stated that in a few minutes they would have burst into flame. The marking ink used was lampblack thinned with kerosene. Although the heat from the exposure was at times intense, no damage was done beyond the burning of the gloves.

S-23090. Button Factory. Owing to the failure of the sprinkler alarm, due to the screen in the variable pressure chamber being clogged with rust and scale, sprinklers probably operated on this fire for forty-five minutes before discovery. The first notification of the fire, which occurred on the fourth floor, was from water dripping through the ceilings to the basement. A hundred or more bags of vegetable ivory dust used to absorb the water on the various floors prevented the water loss from being much heavier than it was.